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THE SAFETY VALUE OF THE DIRECT MEASUREMENT OF THE SURFACE DOSE IN X-RAY THERAPY

By PROFESSOR G. HOLZKNECHT

CENTRAL ROENTGEN INSTITUTE OF THE GENERAL HOSPITAL, VIENNA

WE will call direct measurement of dosage (the recent use of the word dosage as signifying intensity, i.e., quantity in unit time, is not accepted in this article), the measuring of the total radiation on or in the body from the beginning to the end of every treatment with the X-ray. This is like measuring a liquid in graduated vessels.

A stream of liquid can be estimated *indirectly* from the cross-section, the velocity and the duration of the stream. These factors are measured; the total quantity of liquid is calculated from them. An indirect estimation of the X-ray is also possible from its intensity, the square of the distance of the tube and the time of exposure.

The *correctness* of the indirect measurements assumes that all factors are correctly measured and that there is no error in the calculation, and also, finally, that none of the factors vary during the radiation, or are inconstant. In direct measurements not only is there no calculation but the number of measurements into which errors may creep is reduced to a single one.

It is therefore not to be doubted that in principle the direct measurement is safer than the indirect one. For that reason in industry and in practical life, direct measuring has been aimed at, whenever it was possible, and to this endeavor we owe the endless lines of direct measuring appliances, from those measuring contents to those measuring the electric current. In X-ray therapy as well, after the early years of indirect measurements (milliampere-minutes), direct methods have been invented (radiometer of Holzknecht, quantimeter of Keinbock, Sabouraud, G. Schwarz, Freund, Bordier, Voox, Hampson) and they are just now being perfected (ioniometric roentgen ray meter). The claim heard occasionally that the direct dosimeters do not work in deep therapy is not well founded, and that their measuring devices are not affected by strongly penetrating rays is entirely without a basis of fact. That they are affected in different degrees by rays of varied penetrating power is only an apparent objection; in reality, with equal penetrating exposure we have always the same degree of change and the same dosage.

Besides these, we find used again and again, indirect measurements, with the measuring of all factors from time to time and the attempt made to keep the result, the power of the rays, constant, in order that in the individual case only so much or so many minutes' exposure need be used; that is, to use a dosage simply according to a clock, to avoid the inconvenience of making individual measurements. The clock strikes at the end of the determined time, the signal to end the exposure. That is indeed a very simple procedure *but not ad-*

missible if it does not suffice to prevent injuries. Such injuries frequently occur with beginners and with intentional or accidental changes in the apparatus. Otherwise they occur more seldom, but nevertheless among hundreds of exposures they are unavoidable and not exactly rare even when one is inclined to feel most safe. The number of injuries rises with the introduction of new methods and with the wider use of X-ray apparatus, which is becoming more and more simple of application, but never falls to zero. The individual case of acute injury, because of the danger of the necrotic effect of the ray, is always a great misfortune, and because of the long duration and great painfulness of X-ray injuries is juristically an easily actionable one, with serious psychic disturbances to doctor and patient.

For these reasons the convenience and simplicity of dosage by the clock is not to be recommended. On the contrary, both in surface and deep therapy so important a point as proper measurement is not only to be carefully observed but made doubly safe from errors, as every measurement may occasionally go wrong. In other words, two independent measurements are to be made and the exposure is to be stopped when one of these shows that the limiting dose has been reached. My recommendation of a double guard against over-dosage (Versammlung der Naturforscher und Aerzte, Leibzig, Sektion Roentgenologie, 1922, und Munchner Medizinische Wochenschrift, 1922) was later declared impracticable on the grounds that "by using two independent methods of measurement one would not know finally which method should in the end determine termination of the exposure." It is clear, however, that there is no difficulty when the two methods agree, and, similarly, when the two methods do not agree one of them has been in error and that, in such a case, the apparatus which indicates the intended dose must be cut out.

Following is a case which, because of its peculiarity, will make clear all that has been said. A doctor bought a new X-ray apparatus and calibrated (as we call the first measurements on "Phantoms") the apparatus on the basis of instructions his teacher and the manufacturer of the apparatus had given him. He thought that these measurements told him at what exposure, at what distance and field and in what time his apparatus would yield a full dose. Some feeling of doubt caused him to make the first trial exposure on his own body. The result was a deep ulcer, which was later removed surgically. If he had only put a measuring plate of a dosimeter on his skin, the plate would have warned him long before the end signal of the indirect method.

It would be wrong to assume that the double measurement of the dosage is complicated. Among the direct dosimeters there are some simple ones and of the indirect ones those modifications are the simplest and most to be recommended in which only the time is measured. These are widely known, so that in practice nothing further need be done than to use with this a direct dosimeter in every exposure, or at least with high dosages and in places of cosmetic importance.

For the beginner the simplest method may be outlined here, one which offers perfect security and which can be indefinitely improved later in regard to accuracy. It is based on the dosage tables of I. S. Hirsch, M.D. (Principles and Practice of Therapeutic Technique, with Dosage Formulæ and Dosage Tables by G. Holzknecht). This table reduces all possibilities to eight fundamental degrees of dosage and gives, with the aid of a simple, direct dosimeter, the dosage for all the cases of deep and superficial affections. At first one proceeds in practice only according to directions, but later one begins to note down at each exposure the combinations, distances, and periods of exposure in order to finally use the periods of exposure as a second control method.

Starting with this easily learned method of measuring doses, which has the fewest sources of error, one can progress to a

marked degree of perfection. To this end one applies the same exposure to the ordinary "phantoms" (water, wax, etc), instead of to the body, and controls the exposure, with the best available instruments, to gauge the penetrating power, wave length, intensity and distribution of intensity, correcting the original arrangement according to the data obtained. One obtains thus every possible degree of exact and modern technic of measurement without risk of various sources of error involved in the more difficult methods.

The possibility of occasionally using too small doses is of no weight even with malignant tumors, since the stimulating effect of small doses has been recognized as due to an error, and the "carcinoma-dose" has had to be abandoned in favor of the tolerance dose of normal tissues.

The most important errors which the direct measurement helps us to avoid may be briefly indicated here. When the filter is forgotten the dosimeter shows in a short time an extraordinarily high dosage. In case of error in distance of tube from skin, the dosimeter gives automatically the real distance, since its exposure plate lies on the skin. It thereby also protects the patient from too small doses. It saves one from exact measurement of distances in skin and in deep therapy cases and permits in skin therapy the use of distances independently of the effort to produce proper dosage altogether, and without compromise in the interest of the evenness of exposure in all parts of the field.

It is self-understood that new methods following one another rapidly are said to be ideal and older ones to be superfluous. But it is becoming more and more evident that safety demands a compromise in this respect. For this reason the author, in spite of having his name attached to one of the direct dosimeters, could not delay further from a warning and from discussing in detail the necessity of doubly safeguarding the dosage of direct and indirect measurements.

EDITOR'S NOTE—This office is indebted to H. Steglitz Kuhn, M.D., Chicago, for the translation of the above article, which is published with the approval of Dr. I. Seth Hirsch.

INSTRUCTION OF UNDERGRADUATES IN ROENTGENOLOGY[1]

By P. M. HICKEY, A.B., M.D., Ann Arbor, Michigan

THE use of the microscope in the study of the structures of the human body and in the diagnosis of disease has become so universal that training in microscopy is now a matter of routine in premedical and medical studies. The use of the roentgen ray in the study of normal anatomy and physiology is fast assuming a place of equal importance with the microscope. The roentgen ray in the diagnosis of pathologic conditions has already assumed a position of co-equal importance with the microscope. Years ago in medical colleges microscopy was classed as an elective study, a condition which gradually changed, until now the study of minute lesions and their consequences is a matter of daily routine. As roentgenologists we must face the problem of advancing the study of roentgenology in our under-graduate course, otherwise students will be graduated with a serious handicap. The roentgenogram and fluoroscope furnish as important methods of studying anatomy, physiology, and gross pathology, both living and dead, as the microscope. A survey of the courses in roentgenology given in many of our medical colleges shows that the importance of this new art has not been recognized to the degree of according it a proper place in the modern medical curriculum.

Granting that the importance of roentgenology is sufficient to have courses given for the proper education of medical students in its use, the problem then changes to a discussion of the best way in which these courses can be given and the length of time proportionate to its importance. It is seriously recognized that our present systems of medical education are sadly deficient in the proper correlation of studies and in an adjustment of their relative importance. It is also well known that the medical student of the present time is sadly overworked. The edifice of medical education is now a rambling structure with many wings and additions which have been added from time to time without the proper architectural plan of a well-arranged structure. The amount of time spent on subjects of relatively slight importance, the amount of work spent in the momentary acquirement of useless detail, makes it difficult, perhaps unwise, to try to add more hours to the educational plan of medical students.

It has therefore been the writer's idea that the standpoint of the roentgenologists should be to introduce into the plan of medical education the more common use of the X-ray in the now established courses of study. For example, in the study of osteology, the student should be provided with proper facilities for acquiring a concept of the bones from the standpoint of X-ray studies at the same time that he acquires visual ideas of the shape and contour of the bones as learned in the dissecting room. This can be accomplished by placing in the dissecting room and in the anatomy lecture and study rooms well-executed films or plates of the normal bones of the body. This procedure would not entail the infliction of more hours in addition to the now overcrowded study of anatomy. In the same way, when the student is studying the joint structures, he can become familiar with the X-ray appearance of normal joints. We feel that the study of roentgenology in a medical school should begin in the first year with the study of anatomy and that the medical student should regard the X-ray as a tool like the microscope which will give him another approach or another viewpoint in the study of anatomy.

A similar method could be followed in the study of physiology. When the student is confronted with the problem of learning the basic facts about respiration he should have the opportunity of studying the action of the diaphragm, the coincident changes in the intercostal spaces and the

[1]Read before the Radiological Society of North America, December 5, 1923, at Rochester, Minnesota.

increased radiability of the lung. In studying the problems of circulation he should have the opportunity of fluoroscopically observing the heart's action in the animal as well as in the human. It is needless to point out the added information which the careful student would acquire in studying the physiology of digestion through the use of the contrast meal and the fluoroscope.

In pharmacology the action of drugs from the fluoroscopic standpoint in the accentuation or retardation of the phenomena of respiration, circulation, and digestion would have a very practical application and produce more lasting impressions than he receives at the present time. If Cannon was able to do some of these interesting experiments while yet a medical student, it is perfectly right to suppose that in a well regulated and carefully supervised laboratory these procedures could be carried out.

In pathology also the density of various tissues as revealed by the roentgen ray would constitute another method in the study of gross lesions.

In a course of roentgenology given either in the junior or senior year in a college where such preliminary use of the roentgen ray had been made a part of the student's daily routine, the practical demonstration of the diagnostic uses of the ray would be possible with an interest on the part of the student which at present is not usually manifest. Too many of the courses we find are burdened with long lectures on the electron theory, a general subject which should be strictly premedical. It is the writer's experience that if the practical applications of the ray are presented to the students so that they realize the everyday use of the ray, the student's interest is increased and he pursues his work in this special line with considerable interest.

It is recognized at the present time that our former ideas about education were not based on a true psychology and that the proper way to approach the problems of education is to arouse the interest of the pupil so that he will set the task for himself, instead of blindly following a prescribed routine. In other words, if the pupil can be made to see the value to himself of a given study, he will tend to follow it of his own volition and regard his teacher not as a taskmaster, but as one who will help him with his problems. The medical schools of the country are so encased in tradition and established routine that the appreciation of these now well recognized principles of education will be very slow of introduction in many of the older subjects. However, with a new subject such as roentgenology there presents a most wonderful opportunity for demonstrating the value of this new viewpoint.

Questions arise in teaching roentgenology as to how much time should be spent on the special subject of technic. It is our belief that, inasmuch as the doctor of the future will use his X-ray machine as frequently as he does his stethoscope or microscope, it is the duty of our colleges to teach a certain amount of elementary technic. This view perhaps is somewhat radical, but we believe its position can be justified. One has only to talk with the graduates who find it necessary to make use of the ray in order to keep abreast of the times to realize the handicap under which they labor. During the past year at the University of Michigan certain elective courses have been offered in roentgenology, one of which took up the special subject of technic. It is a matter of considerable surprise to find the large number of students who elected this course and found time for its study in addition to the prescribed work of the senior curriculum. It was a matter of further surprise to find how quickly they acquired a working knowledge of the X-ray in the simpler problems, for example, of fracture. Perhaps I hear someone say, "A little knowledge is a dangerous thing," and that no one should do X-ray work who is not well trained in the subject. The same observation can be urged about surgery, internal medicine, or any of the other great divisions. We consider that it is more beneficial to mankind to have the doctor trained in X-ray work while he is in college than

that he should graduate without much knowledge of X-ray work and take his lessons from some sales agent who is willing to give him a few hours' time as a bonus for the sale of the machine. It has been a matter of interest also to find that there exists such a large percentage of medical students who are willing to find time to take elective hours in special plate-reading of the chest for which they receive no hours of credit.

It is an unfortunate consequence of the newness of the art of roentgenology that some of its followers, of necessity, through lack of proper training, are doing poor X-ray work, both from the standpoint of technic and from the standpoint of interpretation. We think that this condition will continue to exist until the colleges themselves remedy the condition by proper methods of undergraduate instruction. It may be argued that roentgenology is a specialty like ophthalmology, laryngology, and neurology and that instruction in it should properly belong to the post-graduate period of education. A broader viewpoint would be to consider that roentgenology should not be regarded ultimately as an exclusive specialty, but should be regarded as a means of diagnosis having a very broad use in the daily practice of every conscientious physician and surgeon.

SUMMARY

The summary of the points which we wish to emphasize in this paper is as follows:

1. There is a constantly increasing demand for better and more thorough instruction in roentgenology in our undergraduate courses.

2. It is the duty of the roentgenologic profession to present to the American colleges the need of a broader view of teaching roentgenology to medical students.

3. The use of the roentgen ray should be regarded not only as a means for help in diagnosis, but it should be considered as an instrument of great value in the demonstration of many of the basic facts in the primary medical studies.

BURNS, J. E.: CANCER OF THE PROSTATE; DIAGNOSIS AND TREATMENT. *Jour. Mo. St. Med. Assn.*, 1923, XX, 191.

X-ray therapy is a very helpful adjunct to radium therapy in the treatment of prostatic cancer and should always be given by a thoroughly competent roentgenologist. Exposures should be given to the sacral, perineal and suprapubic regions, these regions having been carefully mapped out previously so as to avoid overlapping of exposures. Lately the use of the high-powered X-ray machine has greatly advanced this form of therapy. X-ray treatment is especially valuable in the treatment of metastases; its use is also indicated after any operative procedure to kill off any stray cancer cells that may have been spread around during the operation.

A STUDY OF VENTRICULOGRAPHY[1]

By ALFRED W. ADSON, M.D., WILLIAM O. OTT, M.D., and ALBERT S. CRAWFORD, M.D.

Section on Neurologic Surgery, Mayo Clinic, Rochester, Minnesota

UNTIL Dandy called our attention to the ventriculogram in 1918, the X-ray had been restricted in the diagnosis and localization of intracranial tumors to cases in which the neoplasm contained calcium, or had produced skull changes, either in the form of erosions or hypertrophies. Dandy unquestionably has given us the greatest amount of information concerning the technic and value of ventriculography. Many surgeons have reported isolated cases or very small groups of cases. Grant, in reviewing forty-five cases on Frazier's service, has described some of the problems and difficulties encountered in employing ventriculography. McConnell, in his review of fourteen cases, reports eight successful or positive ventriculograms and six unsuccessful.

In analyzing our own cases we have attempted to determine whether or not we have employed ventriculography as often as we should to determine its value in localizing lesions and to ascertain the number of patients improved or cured as a result of this additional aid in diagnosis. A series of seventy-five cases in which ventriculograms were made is presented with a view to determining the efficacy and the surgical risk of ventriculography. This series is relatively small, but we feel that it is sufficiently large to present the usual problems encountered in the diagnosis and treatment of unlocalized brain tumors.

Our series dates from July 27, 1920, when the first ventriculogram was taken. A brief review of the records of all brain tumors that have been observed in the Neurologic Department since that time is presented. Of the 532 patients observed, 251 have not been operated on; 29 refused operation. The condition of 87 was considered inoperable, either because the patients were moribund at the time of examination, or because of the inaccessibility of the tumor. Twenty-two cases of non-surgical brain tumors came to necropsy; in 20 the diagnosis was corroborated, and in two it was not corroborated. One hundred thirty-five of the patients treated medically were held under observation, the patients being instructed to return to the Clinic from time to time. Certain of these patients had but few complaints; it was difficult to diagnose the condition of others.

It is a question, therefore, whether there are means besides the usual clinical, laboratory and neurologic examination that will aid in the diagnosis and localization of brain tumors. In cases in which the histories or findings are questionable or indeterminate, we resort to ventriculography for aid in the localization of incipient brain tumors rather than defer diagnosis and treatment until the lesions become extensive and result in permanent destruction. From a review of the literature, and of our own cases, it is evident that the ventriculogram is of distinct value in the localization of brain tumors, but inasmuch as the largest percentage of brain tumors are infiltrating gliomas, the surgical possibilities are limited.

Even in the face of the limited number of cases which can be successfully treated by operation, if ventriculography makes it possible to detect the operable cases earlier, and to eliminate the inoperable, its use is justified. Two hundred six of the 532 patients were advised to have, and accepted, exploratory craniotomies; of these 137 had certified tumors and 69 were uncertified. In all cases in which the tumors were verified, the neoplasm was either removed, or partially removed, and a specimen, or necropsy material was examined for diagnosis. In cases in which the findings were not verified, the lesion, if present, was sub-

[1]Read before the meeting of the Radiological Society of North America, Rochester, Minnesota, December 3 to 7, 1923.

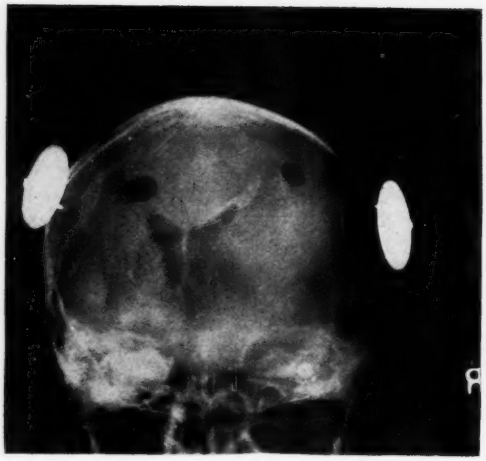

Fig. 1

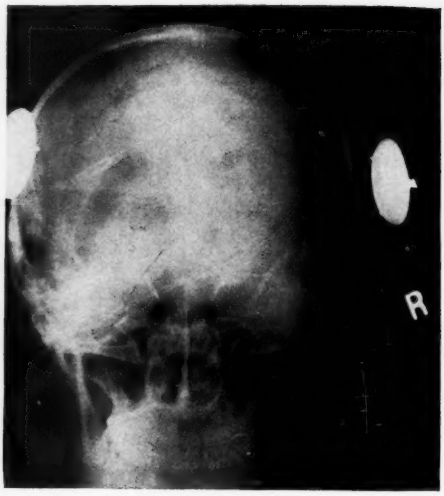

Fig. 2

PLATE I (Figs. 1 and 2). Case A403843. Tumor of the right temporoparietal lobe. Fig. 1. Occiput down; both ventricles pushed to the left. Fig. 2. Forehead down; right posterior horn partially obliterated; left posterior horn filled. Diagnosis from ventriculograms: Tumor of the right temporoparietal lobe.

cortical and deeply situated, so that it seemed inadvisable to obtain a specimen for pathologic examination.

In reviewing again the 206 surgical cases, we found that in 13 there were shadows within the brain substance brought out by stereoscopy, and caused by calcium deposits; 12 of these were brain tumors, and 1 was an organized hematoma. Two roentgenograms showed a localized erosion resulting from endotheliomas; marked hypertrophy, causing an osteoma to develop over subdural neoplasms, was shown in seven cases. There were several tumors of the skull itself, without coincident brain tumor, which are not included in this series. The roentgenograms gave evidence of localization in but 22 (8 per cent) of the cases of brain tumor. Aside from the more specific findings, there was evidence of erosions from the convolutions on the skull in 8 cases, erosion of posterior clinoids in 17, and enlargement of the sella in 24 without evidence of primary pituitary disease, the typical pituitary cases not being included in the series.

At first we were cautious in advising the use of ventriculograms, and did not advise it for patients who gave the slightest signs of localization. In the first few cases we used it in conjunction with a decompression, but soon learned that this was unsatisfactory, inasmuch as it did not reveal whether or not there was any encysted hydrocephalus in the opposite ventricle. The technic now employed is the tapping of the posterior horn of both lateral ventricles. The patient is placed on his back with the head on a small hard pillow and with the head of the table elevated; we then choose a point for trephining 3 to 4 cm. to the right and left of the middle line, and 3 cm. above the lateral sinus. Local anesthesia is used; the field, after being prepared, is injected with novocain and the trephine openings are made in the skull. After opening the dura, a trocar and cannula are inserted into the brain in a direction toward the tip of the ear. As the ventricle is entered, fluid will be seen to escape; the cannula is immediately withdrawn sufficiently to prevent the escape of cerebrospinal fluid, and is at once connected with a small rubber tube which is, in turn, connected with a recording glass

syringe. The cannula is then re-inserted into the ventricle and 10 c.c. of fluid is withdrawn; the small rubber tube is compressed, or if the stop-cock is used, it is closed until the fluid is emptied from the syringe, and 8 to 10 cm. of air is then injected into the ventricle. This procedure is repeated until all of the fluid on one side is removed. The head of the table is then lowered without disturbing the position of the head with the occiput down; this is done in order to empty all of the fluid from the anterior horn of the ventricle, after which the head is rotated to the right and if a considerable quantity of fluid continues to collect, one is led to infer that the fluid is coming from the opposite side. If no fluid appears after turning the head to the right, the second trephine opening is made over the posterior horn of the left lateral ventricle, and the same procedure is repeated, after which the wounds are closed and covered with celloidin dressing.

In a few of our earlier cases the patient was transferred to the X-ray room, but on account of the inconvenience, a portable X-ray machine was later brought into the operating room. The first ventriculogram is usually taken with the left side of the head on the plate; in order to secure an accurate plane we have developed a head rest, which holds the head firmly while the roentgenogram is being taken. It is very important in the first roentgenogram, when the side of the head is on the plate, to keep the sagittal suture parallel with the plate; the head rest is so constructed that plates or films can be inserted and withdrawn without disturbing the head. The same procedure is then repeated with the right side of the head down on the plate; it is always well to rotate the head slowly a number of times before it is finally placed in the fixed position. The third plate is made with the occiput down, the sagittal suture being perpendicular to the plate (Fig. 1); the head is again rotated from side to side slowly, in order to equalize the air in the event there is some fluid left in the ventricles. The fourth plate is made with the patient lying face downward (Fig. 2), and the sagittal suture perpendicular to the plate, the same procedure being carried out with regard to rotating the head to equalize the

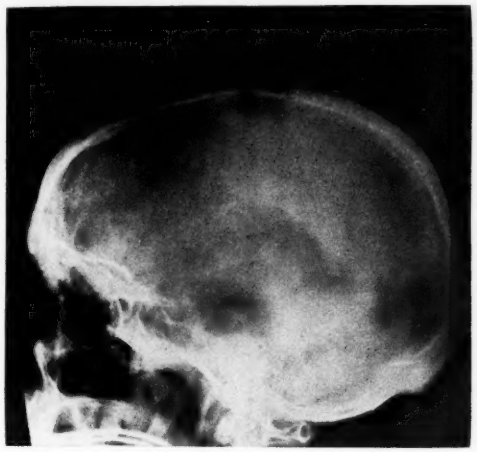

Fig. 3. Case A398433. Left frontal lobe tumor. Left lateral ventricle with obliteration of anterior horn. Other films of this series, not shown here, show right lateral ventricle normal except for some obliteration of the tip of the anterior horn. Anteroposterior views show right lateral ventricle dilated, with obliteration of the left anterior horn. Diagnosis from ventriculograms: Left frontal lobe tumor.

air before making the exposures. Occasionally a fifth plate is made by lowering the head of the operating table with an attempt to force air into the aqueduct or fourth ventricle, the X-ray plate being placed parallel to the sagittal suture on the one side and with the X-ray tube on the other side. Following this, the patient is returned to his bed unless there is nausea and complaint of headache; if so, the wounds are opened and a part of the air is withdrawn. This latter procedure may have to be repeated after from twelve to twenty-four hours if the patient shows signs of increased intracranial pressure. If it seems wise to determine the degree of intracranial pressure, one can attach the mercury manometer to a brain cannula with a

tube during the removal of cerebrospinal fluid.

The interpretation of ventriculograms requires considerable study, and is worked out in conjunction with the radiologist. If two shadows appear in the lateral view of

Fig. 4. Case A412704. Left parieto-occipital tumor. Left lateral ventricle; posterior horn partially obstructed with upper part of inferior horn pushed forward and upward. The other films of this series, not shown here, show the right lateral ventricle normal. Anteroposterior views show right ventricle normal in size, flattened and pushed to the right, and the left lateral ventricle partially filled anteriorly, flattened and pushed to the right; no air in the posterior horn. Diagnosis from ventriculograms: Left parieto-occipital tumor.

the ventricle, a fainter shadow indicates the ventricle farther from the X-ray plate, and not too much importance should be placed on the contour of the darker shadow, which is the ventricle nearer the plate and which is improperly filled. It may be impossible to obtain more than a few cubic centimeters of cerebrospinal fluid in one ventricle, while from the opposite ventricle a large quantity may be withdrawn; one may also obtain but a small quantity of fluid, 10 to 20 c.c. from one or both ventricles, and experience difficulty in attempting to inject air, inasmuch as the patient may complain of pain or begin to vomit. In a few instances in our experience the patient developed convulsions, so that it was necessary to remove part or all of the air immediately. In some instances it may be possible to inject from 10 to 30 c.c. of air, but this quantity may partially escape after the cannula is withdrawn, and the X-ray film will show an indefinite shadow with improper filling of the ventricle. Occasionally only a few drops of cerebrospinal fluid are withdrawn; in three cases we were unable to obtain cerebrospinal fluid from either ventricle.

In this series are 72 cases in which we obtained either good or indeterminate ventriculograms, and 3 cases in which we could not obtain any cerebrospinal fluid, and hence no air was injected. We have divided the patients into two groups: Group 1 includes those presenting symptoms of increased intracranial pressure, but no symptoms of localization; Group 2, those in whom there were symptoms of increased intracranial pressure and some slight suggestive sign of localization, such as localized tenderness, nystagmus, stiff neck, questionable Babinski, *grand mal* convulsions with a suggestive Jacksonian onset, frontal lobe deterioration, and also four patients who had had previous operations with negative findings.

In Group 1 there were 47 cases; in 29 of these the ventriculograms were positive; in 16, indeterminate, and in 2, misleading. In Group 2 there were 25 cases; in 16 of these the ventriculograms were positive, and in 9 they were indeterminate. Besides these two groups there were three cases in which we were unable to obtain entrance to the ventricle, or if we did, could not obtain any cerebrospinal fluid, so that no air was injected.

In 33 of the cases in which ventriculograms were made, the brain was explored, 30 on positive ventricular findings. Twenty-four of the lesions were verified; 4 were not verified, and the findings in 2 were misleading. Three patients were explored on clinical suggestion of localization, in the absence of a positive ventriculogram; in 2

a lesion was found; in 1, it was not verified. The remaining patients in whom ventriculograms were made were dismissed because the ventricular findings and clinical suggestions indicated a lesion of the basal ganglia or brain stem, or else a deep-seated, inoperable lesion. A few patients were dismissed because we were unable to give a definite prognosis; others, in whom the ventricular findings were indefinite, were dismissed for further observation; one patient was dismissed because the ventriculograms revealed normal ventricles, and he has since returned with no choked disc, and free from symptoms.

Of the 33 patients explored, the lesions were removed from 4; 1 patient had a frontal lobe abscess, 2 had old hematomas, and 1, a tuberculoma. Tumors were partially removed from 5 patients; 1 had a cystic degenerating glioma, and 4 had gliomata which had extended to the surface of the brain. We have been able to verify at exploration, or at necropsy, the localization of neoplasms in 46 of the 75 patients; 11 of these had frontal lobe lesions, 13 had temporal lobe lesions, 7 parietal, 9 were of the brain stem or infratentorial, 4 were suprachiasmal, and 2 were intraventricular lesions. Of this series, besides one brain abscess, two hematomas, and one tuberculoma, there were two endotheliomas; one arose from the falx cerebri above the chiasm, and the other was an inferior frontal growth. The first case came to necropsy, and in the other we were compelled to abandon procedures during the first operation on account of hemorrhage; before we were permitted a second attempt to operate, the patient died. The remaining group of the 46 verified lesions is composed of extensive infiltrating tumors of the gliomatous type (Figs. 3, 4, 5 and 6).

There were six deaths within thirty hours following ventriculography.

ABSTRACT OF FATAL CASES

Case 1 (A445873). A woman, aged thirty-seven years. Under local anesthesia 10 c.c. of cerebrospinal fluid, slightly blood-tinged, was withdrawn from the right lateral ventricle, and an equal amount of air injected; no fluid was obtained from the left lateral ventricle; the ventriculograms were indeterminate. Death, four hours after ventriculography was performed, was due to respiratory failure, and necropsy revealed a cystic glioma of the left frontal lobe with small ventricles containing a very small blood clot, equivalent to 10 or 15 c.c., in the posterior horn of the right ventricle where the cannula had injured the choroid plexus.

Fig. 5. Case A403091. Intraventricular tumor. Left lateral ventricle, posterior horn dilated; tumor projecting into the ventricle. The other films of this series, not shown here, show the right lateral ventricle dilated; anteroposterior views show right lateral ventricle dilated, no air in left lateral ventricle. Diagnosis from ventriculograms: Left intraventricular tumor. Specimen removed at necropsy showed glioma of the left middle brain, pushing into the left lateral ventricle.

Case 2 (A341637). A woman, aged twenty-six years. Under local anesthesia 50 c.c. of clear cerebrospinal fluid was withdrawn from the posterior horn of the right lateral ventricle, and 40 c.c. of air injected. The patient became very ill, vomited, became cyanotic and stopped breathing; the air was promptly removed and artificial respiration instituted. She regained consciousness and the wound was closed. Roentgenograms were taken to determine whether or not any air remained in the ventricle; the diagnosis was indeterminate. The patient was returned to her bed, and in thirty minutes developed respiratory failure, but was kept alive by artificial respiration for ten hours. Necropsy

revealed a glioma of the posterior-inferior portion of the left temporal lobe.

CASE 3 (A406445). A man, aged forty-three years. Under local anesthesia 60 c.c. of clear cerebrospinal fluid was removed through an old right subtemporal decompression, but only 20

Fig. 6. Case A404963. Suprachiasmal tumor. Anteroposterior view with occiput down shows the anterior horns of the lateral ventricles slightly dilated and elevated, third ventricle not filled. The other films of this series, not shown here, show: forehead down, posterior horns filled and separated, no air in the third ventricle; both lateral views show incomplete filling of both bodies of the lateral ventricles. Diagnosis from ventriculograms: Tumor in the region of the third ventricle.

c.c. of air could be injected. The patient became comatose; the air was removed; ventriculograms were taken and showed a filling defect in the body of the left lateral ventricle. The patient died within twelve hours, and necropsy revealed a cystic glioma of the left temporoparietal lobe.

CASE 4 (A360369). A boy, aged twelve years. Under local anesthesia 450 c.c. of clear cerebrospinal fluid was withdrawn from the posterior horn of the right lateral ventricle, after which 420 c.c. of air was injected. The ventriculogram revealed bilateral internal hydrocephalus with an obstruction in the aqueduct. The patient died suddenly twelve hours later, and necropsy revealed a glioma of the corpora quadrigemina with obstruction of the aqueduct, extreme internal hydrocephalus, and pressure atrophy of the calvarium.

CASE 5 (A438477). A man, aged thirty-one years. Under local anesthesia 15 c.c. of clear cerebrospinal fluid was removed from the posterior horn of each lateral ventricle; equal volumes of air were injected into each ventricle, and on inserting the air into the right lateral ventricle the right pupil became dilated and there was bilateral spontaneous nystagmus to the left. Roentgenograms were taken, the air was removed, the right pupil returned to normal size, the nystagmus disappeared and both pupils responded to light. The ventriculograms showed an intraventricular tumor coming from the roof of the right ventricle, with an indentation into the body of the left ventricle. The patient became semicomatose shortly after being returned to his bed; this condition deepened until he became moribund and died fifteen hours after operation. Necropsy revealed a degenerating glioma of the corpus callosum involving the lateral wall of the right ventricle, with 25 c.c. of blood in the posterior horn of the ventricle.

CASE 6 (A409795). A boy, aged twelve years. Under local anesthesia 90 c.c. of clear cerebrospinal fluid was removed from the posterior horn of the right lateral ventricle; on account of obtaining so large a quantity of fluid from this side, only one ventricle was drained, and 65 c.c. of air was injected into the right ventricle. During the procedure the patient complained of slight numbness of the left arm; this quickly disappeared, however, and he experienced no further difficulty. The ventriculograms showed uniformly dilated lateral ventricles and third ventricle, with an obstruction below the tentorium. The boy was free from symptoms for thirty hours, when he sat up of his own accord to eat his dinner; death occurred very suddenly, and necropsy revealed an extensive glioma of the cerebellum involving the vermis (Fig. 7).

There were two other deaths following ventriculography, but these did not occur until from five to seven days after the operation, and were due to deep-seated, inoperable lesions rather than to the ventriculography.

CASE 7 (A413217). A woman, aged twenty-three years. Under local anesthesia 130 c.c. of clear cerebrospinal fluid was removed from the posterior horn of the right lateral ventricle, and inasmuch as fluid apparently came from the opposite side, the posterior horn of the left lateral ventricle was not drained, and an equal quantity of air was injected into the right ventricle. The ventriculograms revealed uniformly dilated lateral ventricles and a dilated third ventricle, with obstruction of the aqueduct. The patient experienced no difficulty following the procedure, and on the second day was permitted

to sit up; she died suddenly on the fifth day. Necropsy revealed internal hydrocephalus of the third and lateral ventricles, due to granular ependymitis.

CASE 8 (A407067). A woman, aged thirty-five years. Under local anesthesia 10 c.c. of fluid was removed from the posterior horn of the right lateral ventricle, and an equal volume of air was injected; 30 c.c. of cerebrospinal fluid was withdrawn from the posterior horn of the left lateral ventricle and this was replaced by an equal amount of air. The ventriculograms revealed deformity of the body of the right lateral ventricle from beneath, and the diagnosis was basal ganglia tumor (Fig. 8). The patient's condition was unchanged following the ventriculography, but she remained more or less drowsy and semicomatose until death on the eighth day. Necropsy revealed a glioma of the right basal ganglia (Fig. 9).

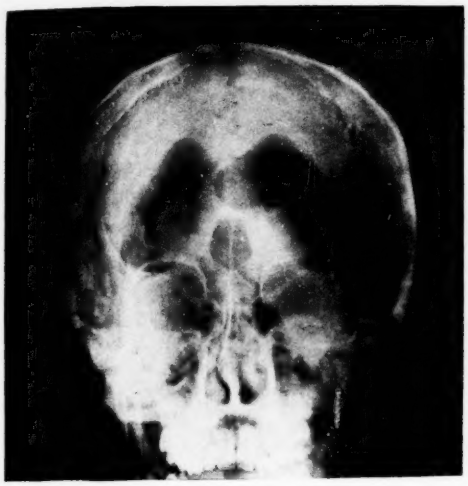

Fig. 7. Case A409795. Tumor of cerebellum. Anteroposterior view with forehead down shows the posterior horns of the lateral ventricles and the third ventricle uniformly dilated. The other films of this series, not shown here, show both lateral ventricles uniformly dilated. Occiput down shows both lateral ventricles and third ventricle dilated. Diagnosis from ventriculograms: Infratentorial tumor.

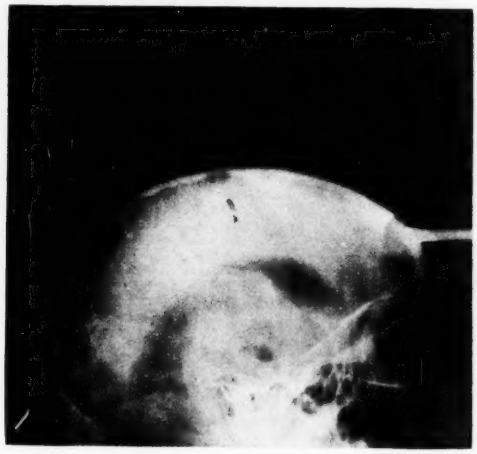

Fig. 8. Case A407067. Tumor of right optic thalamus. Left lateral ventricle shows a narrowing of the body. The other films of this series, not shown here, show the body of the right lateral ventricle narrowed; anteroposterior views show narrow third ventricle and increase of distance between the lateral and third ventricles. Diagnosis from ventriculograms: Middle line tumor involving the basal ganglion.

The lesions in these fatal cases were inoperable, and it is evident that death would have been inevitable. Judging from our experience, it seems probable that death might have occurred instantly in any one of these patients, even though no ventriculography had been performed. In Case 1 the hemorrhage may have been a contributory factor; in Case 2 the removal of cerebrospinal fluid no doubt permitted the pressure to extend more forcibly on the brain stem. In the two patients whose necropsy examinations revealed marked internal hydrocephalus and whose death was sudden, there is some question as to whether or not one is justified in removing the amount of fluid that was withdrawn; this also explains why we did not drain the posterior horn of the left lateral ventricle. In cases 2 and 7 we did not feel that surgery should be attempted and had planned to dismiss the patients without further operation.

DISCUSSION

In reviewing the series, certain facts are outstanding. The ventriculogram aids in the localization of tumors of the cerebrum, but it does nothing more than indicate obstructions below the aqueduct or the tentorium cerebelli. It does not always localize small lesions of the frontal and tempo-

ral lobes, but it does so very readily if there is a unilateral hydrocephalus. Occasionally it is difficult to withdraw sufficient cerebrospinal fluid and to inject sufficient air to obtain a clear ventriculogram when there is a large tumor in the frontal lobe, since the ventricles may be compressed, but not obstructed. There is also some danger of injuring the choroid plexus, if little or no cerebrospinal fluid is present in the posterior horn of the ventricle on insertion of the cannula. In certain cases it is necessary to repeat the ventriculogram, and it is then probably wise to attempt drainage of the anterior horns of the lateral ventricles if a ventriculogram is not successful after draining the posterior horns, since a frontal lobe tumor may be encountered, as in Case 1. While it is true that many of the tumors localized by ventriculography are deep-seated and inaccessible, one should attempt to localize the tumor in every possible case, even if it be a glioma of the frontal, temporal, occipital or parietal lobes. Exploration and resection are justified in some of these cases, while in others they are inadvisable; the use of high voltage X-ray or radium therapy may produce palliative effects. Our course has perhaps been too conservative, yet unless something is attempted to benefit these patients death is inevitable.

Fig. 9. Same case as Figure 8. Specimen removed at necropsy; glioma of right basal ganglion.

Three of the thirty-three patients who were explored were cured; two had hematomata, and one, brain abscess. It is probably not a safe routine procedure, on account of rupture, to use ventriculography in localizing brain abscesses when there is a history indicative of abscess; in the case we have discussed there was no evidence of frontal sinusitis, nor abscess, and we were inclined to believe that the lesion was a tumor. Twelve other patients were improved, a total of only 15 of the series of 75 cases wherein improvement was shown. On all patients explored, and from whom we were unable to remove the lesion, a large decompression was performed at the base of the flap, which no doubt will act as a palliative measure, even though no marked improvement occurred during the hospital convalescence. Although the number of cases cured or improved following the treatment instituted is small, every improvement is worth while, especially when it is considered that most brain tumors are gliomata, situated subcortically and inaccessible for operation.

Ventriculography is a procedure which aids in the localization of brain tumors and should probably be used more frequently than it has heretofore been employed by most of us. Perhaps it should be used as a means of diagnosis as well as of localization of brain lesions, since it is not hazardous for patients who do not have deep-seated lesions. This fact is substantiated, inasmuch as deaths occurred only if patients had inoperable lesions, with the exception of the patient in Case 1, in which hemorrhage was a contributory factor.

In view of the mortality attending ventriculography, it should be used as an ad-

junct in the diagnosis and localization of brain tumors in patients having indeterminate histories and findings, but should not take the place of an exhaustive neurologic examination which indicates localized brain tumors, so that surgery can be instituted.

In making a final diagnosis in cases in which the histories are indeterminate or suggestive, one should consider, first, the history; second, the findings at the time of the ventriculography, and third, the findings revealed in the roentgenograms.

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THE EVALUATION OF X-RAY AND RADIUM THERAPY IN CANCER, AND ITS FUTURE OUTLOOK[1]

By M. J. SITTENFIELD, M.D., New York

AS a general rule, we physicians have a habit of hiding from ourselves the things we do not understand with words and phrases of little meaning. This applies to radium and X-ray in cancer, as well as to the other arts and sciences, and since these agents have made such astounding strides within the past four years, the time is ripe to evaluate their achievements, and, in addition, to build up fundamental principles which will further advance progress. It is essential for our future outlook that we not only recognize the groundwork and foundation laid down by science, but that we construct our general advance upon this basis of accumulated knowledge. In other words, as we forge ahead, it is not well to disregard the essentials, but rather to modify them so that they stand upon a broader and more stable basis.

On the whole, experimental data without imagination, or vision without recourse to practical appliance, can accomplish but little. However, for effective progress a happy blend of these two factors is requisite. But right here let me warn against speculative or philosophical excursions in a field which should obviously concern purely the applied sciences. Far too much of this has crept into a literature already too bulky, only to be discarded as new steps in this science are evolved. After all, it seems to me that the recent advances in technical equipment and physics of X-ray and radium have been allowed to overshadow the biological, anatomical and histological basis for radiation. Even now the greatest interest here and abroad is evinced in the construction of continuous current machines by means of either large condensers, or a series of kenetron tubes—in contrast to the meager research carried on to throw light upon the biological laws concerned with the reactivity of individual tissues to a definite and specific ray. Until an adequate knowledge of these facts is established, however, we are working under a decided disadvantage, and cannot expect consistent results in the treatment of malignant growths.

Malignancy, as we understand it at present, carries with it a hazy conception, at best, of the underlying, inexplicable and complex etiology. For our present purpose let us consider some of the properties of malignant tumors, both clinically and scientifically. The clinical grouping of these newgrowths according to localization and duration of the disease, as well as the size of the tumor, also the organ affected, and the age of the patient, and with it the general constitutional condition, and other indefinite factors, unfortunately offers no clue to the underlying complex phenomena of the varied reaction to a definite therapy. All evidence strengthens the assumption that each malignancy has a specific causation, in some form, subject to various factors, some of which can be clinically determined, whilst others still remain quite obscure.

Aside from the above-mentioned factors, the biological behavior of a tumor in one tissue differs in many respects from that in another tissue, even though they be closely allied or directly adjacent.

To add to this difficulty we at times encounter two or even three distinct histological variations in one and the same group. For instance, in a cancer of the stomach, it is not infrequent to distinguish an adenomatous, scirrhous, and colloidal type of growth, microscopically recognizable in the selfsame tumor. All these indeterminable biological factors render increasingly difficult the interpretation of its peculiar histopathology, or a forecast as to the ultimate outcome or response to treatment. A critical consideration of all these variables makes clear the handicap in foretelling our ability to cope with the disease, on the one

[1]Read before the Joint Meeting of the Mayo Foundation and the Radiological Society of North America, Dec. 5, 1923, at Rochester, Minnesota.

hand, and, on the other, our utter helplessness to offer the patient reasonable hope of relief, in spite of all available data.

My own impression, however, gained from a careful and dispassionate appraisal of my experience of the past twelve years, correlated with that of other earnest and thoughtful workers in the cancer field, makes it sufficiently obvious to require no further emphasis on my part, that radium and X-ray with the modern advances in our armamentarium perform a distinct and real function in the treatment of cancer.

First of all, let us take up malignant affections of the lymphatic system. Here no one can deny that radium and X-ray have proven of greater efficiency than any other therapeutic agents. There are definite types of malignant conditions of the lymphoid system that readily respond to X-ray and radium, even in doses of 50 to 75 per cent of a skin unit dose. Especially is this true in cases where the glands are discretely affected, or where a sarcoma occurs in a solitary gland, in contrast to another type, where there is multiple involvement in a group of glands. In the latter type in general, only temporary results obtain, for here we, most unfortunately, meet with recurrences of the disease that prove finally refractory to further radiation.

Even in the multiple lymphatic occurrences, the clinical manifestations may be held in abeyance for a number of years in some instances. But in these cases, even where radiation may not have rendered the ultimate outcome more hopeful, at least it makes the present condition less desperate.

This astounding response to radiation in cases of lymphomatous tumors of the lung, as lymphosarcoma, or Hodgkin's disease, is utilized at the Massachusetts General Hospital as a diagnostic differential sign from other conditions, especially carcinoma and tuberculosis of the lung. Everyone has doubtless been struck with the rapid regression of these lymphatic tumors under the influence of radium and X-ray. On the other hand, it is conceded by almost everyone that surgical intervention in this group of cases is most unsatisfactory, as it seems to hasten its spread and rapid dissemination.

In consideration of the subject of cancer of the cervix, the greater number of surgeons are falling in line, and concede that in Group I, radium and X-ray offer an equal, if not better, chance for ultimate cure. On the other hand, it is my firm conviction that surgical intervention, without radiation, in the early cases of cancer of the cervix, does not yield the same hopeful results.

In Groups II or III pre- and post-operative radiation will promote the best interests of the patient, though you all know the percentage of cases with five-year freedom from the disease in this type is very small. If we compare the results obtained in this type of case with those that have not had the benefit of radiation, it must strike home that very frequently in just this type many of these unfortunates experience a sense of wellbeing for some time, by a gain in weight and strength, and freedom from pain, with a prolongation of life in comparative comfort, even though the disease recurs to prove eventually uncompromising despite all our efforts.

The subject of cancer of the breast, as some of you know, has been of particular interest to me for some years, and to this end, I have been in communication with a number of our foremost surgeons and radiotherapists, to correlate our experiences in the results obtained in this class of cases. To put it briefly, it was most surprising that some acknowledged their timidity to express a definite opinion, others stated that radiation had not at all improved their results, whilst still others were equally convinced that pre- and post-operative irradiation gave the most hopeful prospect. After careful study and analysis of this situation it became clearer to me why there exists such diversity of opinion among the surgeons.

Perhaps I can do no better than to analyze my own cases, and no doubt the same conditions prevail with every cancer work-

er. Summarizing my own 138 cases of carcinoma of the breast treated in my private practice during the last four years, where I have been able to follow them carefully and study the final outcome, it occurred to me just why this chaotic impression existed. I know it will surprise you, as it has astonished me, that the percentage of cases showing freedom from the disease over a period of from one to four years after prophylactic radiation, yielded 83 per cent. Of course, a longer time-interval may force a revision of these figures. In explanation of this statement let me emphasize that I refer to cases which were radiated anywhere from 10 days to 6 months after radical excision, and in which there were "*No recurrences or any clinical manifestations of the disease at the time of the prophylactic radiation.*"

In contrast to these, however, I am not particularly proud of the cases which presented themselves either with carcinomatous supraclavicular glands, or where recurrences of the disease were evident, either in the field of operation or in the axilla, or where there was involvement in the opposite breast. In the latter group results were very unsatisfying, yielding less than 20 per cent. This contrast in figures necessarily makes a strong plea for radiation before there are manifest recurrences. After all, we must not lose sight of the fact that radium and X-ray, as we employ them in these recurrent cases, act purely as local agents for a disease which has already become systemic. Our failures in the latter group presuppose the assumption that either cancer nests were not eradicated by the operation, or that the lesion was inoperable at the time of excision.

Right here I wish to avail myself of this opportunity to deny and rectify a fallacy that has crept into the literature of the past few years, namely, that small doses of X-ray and radium, less than 40 per cent of a skin unit dose, will stimulate dormant or latent cancer cells into renewed activity. For instance, a ridiculous statement appeared in an article by Endler, quoted by Bumm in the July number of the *Zeitschrift für Geburtshülfe und Gynäk.*, in which he blames the radiation for the occurrence in three cases of a tumor of the pleura, six months after post-operative radiation, following radical excision of carcinoma of the breasts. Only too frequently just such unintelligent misinterpretations appear in the literature, for you will all agree that pleural involvements after cancer of the breast have confronted the best of surgeons, even without prophylactic radiation.

Whilst it is perfectly true that in the recurrent group prophylactic radiation has been on the whole unsatisfying, nevertheless there is no evidence that this can be ascribed to the effects of radiation. On the other hand, there is absolutely no proof today that either radium or X-ray is able to stimulate or cause a quiet or dormant cancer cell to flare up—in fact, histological studies at Aschoff's laboratory and elsewhere of the effect of small doses of X-ray and radium upon the thymus and other radio-sensitive organs have brought out only too clearly that not alone is there no evidence of stimulation, but instead, considerable destruction of the component parts of the tissue, besides the obliterative architectural changes recognized microscopically.

It seems to me that entirely too much stress has been put upon this stimulating effect of X-ray, only after careful study and experimentation to be discarded as another false lead. If tumor tissue were stimulated by the absorption of less than 40 per cent of a S.U.D., for example, then it would seem that every cancer treated with the old technic must have been stimulated to increased rate of proliferation. We all know, however, that even with very small doses, some tumors responded to radiation and receded.

The gratifying response in the superficial basal cell epitheliomata, and also accessible malignant lesions of the lip, need not be dwelt upon in detail, except to say that it would be difficult indeed to discount lightly the usefulness of these physical agents.

On the other hand, I will not take the time to dwell upon the inoperable carcinoma in the cavities of the body, except to mention that, in general, intra-abdominal malignancy, and especially the type that presents itself for radiation in the vast majority of cases, gave negligible results only, with no hopeful prospects, except for the very occasional brilliant result.

From this brief and general survey and appraisal of X-ray and radium in cancer, it must be apparent that these local agents have not yet clarified cancer therapy to our entire satisfaction. Nevertheless, it must be obvious that our knowledge of wave therapy is just in its incipiency, and with this in mind, we must bend our energy to suggest further studies and co-operation upon the very foundation of the problem. So far we have made use of only the medium and short waves of these two radioactive agents. To all intents and purposes it still leaves a vast and unexplored field, despite the fact that the new data constantly throw more light upon this intriguing problem. For instance, many of the essentials of the specificity of the tissue to waves of light are still to be disclosed. There is, however, new information gradually seeping through.

The German School of Radiologists have held generally that the therapeutic effects of radiations were simply a function of the amount of energy absorbed, but the work of Russ which has appeared recently would cause us to ponder this assumption.

Russ found that there seems to exist a differential action of the different wavelengths of the roentgen ray. He found that it required six times the amount of absorbed hard rays compared to the amount of soft rays, to have the same effect upon the skin—that is, six times as much ray energy from short-wave radiation had to be absorbed by the skin to produce the same effect as with long-wave radiation. With tumor tissue, the ratio was 2.8 to 1. In other words, this opens the question whether the soft ray has the greater effect biologically. At any rate, it would serve to draw our attention to the uselessness of attempting to radiate superficial lesions with hard rays when it requires only one-third the amount of soft rays to obtain the identical effect.

While on the subject of long-wave radiation, the recent work of Murphy may also prove of interest. By the use of very soft rays focused on a small skin area of a rat or a mouse, he reports that he is able to render this radiated area immune to subsequent intracutaneous inoculation of cancer tissue. If, however, the inoculation is subcutaneous, the tumor growth will develop.

More work of this character is desirable to stabilize our present notions of wave biology, particularly in a closely related subject, one that has hardly been touched upon, and which concerns itself with biochemical and biophysical research, namely, the sensitization of tissues to light by means of certain fluorescent substances, which render a tissue biologically sensitive to rays of sunlight. This subject of light sensitization has been my research problem for the past six years, and whilst we have gained considerable knowledge of the action of light upon these substances, its further study seems to give greater promise in the science of wave biology. For example, certain chemical substances and dyes, as Bengal red, eosin, chlorophyl, and hematoporphyrin, etc., have the extraordinary property of rendering a tissue or an animal sensitive to the direct rays of the sun. To illustrate, these substances which under ordinary conditions are harmless, experience, when exposed to the direct sunlight, some unknown biological reaction that renders them toxic under the influence of light. This photochemical reaction, in turn, induces sensitization of the tissues, or, to paraphrase this: Photodynamic substances experience in the sunlight some chemical alteration, and become toxic, inasmuch as they cause death of the animal after a specific and pathognomonic reaction. One of my experiments perhaps will explain this in detail.

If a white mouse is injected subcutaneously with hematoporphyrin in a solution of 1 to 100,000, and kept in the dark, no

reaction whatsoever takes place, but when the mouse is exposed to direct sunlight, it succumbs to definite and specific symptoms of poisoning. To begin with, there is first noticed after a few minutes' exposure, intense itching with the accompanying scratching, then follows marked edema of the external mucous membranes, the lips, nose, eyelids and ears become reddened, puffy and swollen. The animal is in great distress, and after a little while severe dyspnea is noticed, then paralysis of the lower extremities follows, and finally convulsions and death within 45 to 60 minutes. This will happen in every instance, and unquestionably is due to the toxic changes produced by the action of the sunlight or rays of light upon the injected photodynamic substance. As I have stated before, if the mouse is kept in the dark these symptoms do not appear and the animal remains alive and well. To put it in other words, the rays of light are responsible for an entire biochemical change in the injected substance, and render this otherwise harmless agent toxic, and kill the animal with a definite train of symptoms.

To demonstrate further the subacute effect of sunlight upon these substances: When the animal is removed from the light at any time before death ensues, or is exposed to a less intense light, it will recover, though it remains very highly sensitized to light for the future, or it may die from subacute poisoning in a few days.

With diffuse daylight or a lesser degree of sunlight, the animal becomes light sensitive, and remains sick for months in a chronic state. This chronic state of photosensibility manifests itself in gangrene of the ears and nose so that they may drop off entirely, the hair falling out, and other chronic symptoms.

As a clinical example let me cite the experiences of Meyer Betz, who with more devotion to science than concern for his own well-being, injected hematoporphyrin into his arm. Every subsequent exposure to sunlight was followed in each instance by the same distressing symptoms described in the mouse. His face became swollen, his eyelids and lips puffed up, he experienced intense itching, and this state of sensitization to ordinary sunlight lasted for months, but when it finally subsided left no permanent ill-effects.

This sensitization of the tissues to the waves of sunlight suggested to me the possibility of searching for substances which would render the tissues sensitive to X-ray and radium. However, here the great difficulty arises, in that tissues sensitized to one kind of wave-length do not accept a wave of different velocity, and it seems to me further search in this particular field may prove fruitful, and finally yield a solution to our difficulties.

It is indeed characteristic of modern research, that advance in one apparently unrelated line may bring into close correlation important findings, and consequently point the way to future progress. Again, a valuable contribution to the biology of growth which unquestionably will help to clear up our conception of cancer histogenesis, is the admirable work of Drew, who demonstrated a growth-activating substance in cancer tissue. He furthermore pointed out a similar growth-producing substance in normal tissue, when damaged, as a response to injury. There is something highly suggestive in the results brought out by Drew's experiments, that tissues and tumors growing in culture, when grown free from connective tissue elements, grow as undifferentiated sheets, but when connective tissue is added to such culture growths, cellular differentiation sets in. In view of the possible rôle of the surrounding connective tissue as an important factor in the effectiveness of radium and X-ray upon cancer cells, this should be recognized as an important lead. Carrel also has been working with fibroblast cultures along similar lines, with similar results.

My own experiment reported two years ago before the American Association for Cancer Research bears upon this problem. When a rat tumor is excised from the animal, and the tumor emulsion subjected to radiation, it requires 4 to 6 times the nor-

mal dose to prevent its growth when reinoculated. When, however, the tumor is rayed *in situ*, it requires but 1½ to 2 skin unit doses to inhibit tumor growth upon reinoculation. I am not able to explain just why there is this marked difference in the reaction of tumor tissue outside and inside the body of the animal. Until we know considerably more about the biochemistry of ray effects, until then it will be difficult to define these differences. At any rate, it should cause us to reflect and recognize that there is a great deal more to radiation than merely treating a tumor with a definite standardized dose, or high-powered machine. At the same time we must face the fact that our advance in radiation is checked by the lack of information concerning the biological *modus operandi* of different wave-lengths, and this should be the problem of our time.

There never was more pressing need for further knowledge than at present, nor a like opportunity for inspired research, well planned and skillfully executed. It seems to me we are all coming to realize this, and to expect greater promise, but united effort is necessary to put X-ray and radium in their proper places, not to undermine their function on the one side, nor to exaggerate their possibilities on the other. A great deal more work must be done in this direction for a better conception of their biological behavior, or, in other words, the salient points that stand out for our immediate solution for a more promising outlook are,

(1) The determination of the lethal dose required to influence each and every type of malignant growth.

(2) The determination of the radiosensitiveness of one tissue as compared to another.

(3) The clearing up of the notion that we have accepted almost as the working hypothesis of radiotherapy, namely, that there exists increased radio-sensitiveness of cancer tissue compared to that of the normal tissue it sprang from. In other words, is a lymphosarcoma more sensitive to radiation than normal lymphoid tissue, or a teratoma more so than the normal testicle, etc.?

(4) The determination of the exact reaction between a given tissue and a definite wave phenomenon.

(5) A clearer understanding of the exact relationship of the lymph nodes to cancer. Do they function as filters or barriers of a diseased area, or do they indicate the danger point and the extension of the new-growth?

(6) And, most important of all, how are we to meet the seeming decrease in operability in cancer? You are all familiar with the statistics of Melson, who states that the operability of cancer of the cervix has dropped from 56 per cent in 1917 to 24 per cent in 1921, right here in the Mayo Clinic.

These are seemingly the most outstanding features upon the solution of which the future of cancer therapy rests, and therefore should engage the efforts of every cancer worker.

This necessarily forces us to exercise greater caution in the determination of what prospect there is in the one case, and the foresight and judgment that are requisite not to attempt to ray another that promises little, or in which there is not the slightest hope, except for palliation. Incompetence and irresponsibility in technic are not to be tolerated, and will do more harm in the long run than the occasional good. Be a clinician first, and a technician last. Frankness to admit our failures and shortcomings is more instructive than a doubtful piece of research.

In conclusion, let me restate my conviction, that notwithstanding the incomplete evidence I have brought forward in this appraisal of X-ray and radium in the treatment of cancer, nevertheless this evidence is adequate to make probable or even to prove a positive conclusion. At any rate, I wish to emphasize the fact that we are delving in a very much unexplored field of investigation, but one that holds a great deal of promise for the future, and that little by little we are lifting it from the realm of comparative obscurity into that of an exact science.

ROENTGENOLOGIC DIAGNOSIS OF CHOLECYSTIC DISEASE[1]

By RUSSELL D. CARMAN, M.D., Section on Roentgenology, WILLIAM C. MAC CARTY, M.D., Section on Surgical Pathology, Mayo Clinic, and JOHN D. CAMP, M.D., Fellow in Roentgenology, The Mayo Foundation, Rochester, Minnesota

SINCE the detection of the first gallstone shadow by Beck in 1900, the roentgenologic diagnosis of cholecystic disease has become of increasing interest to the roentgenologist, internist and surgeon. As a result of the careful observations and improvements in technic developed by such men as Cole, Case, Pfahler, George, Knox and Roberts, the shadow of the elusive gallstone was demonstrated with increasing frequency. With the advent of the double intensifying screen and further technical improvements, George and Leonard were able to demonstrate a shadow which they believed represented a pathologic condition of the gall bladder, as, in a number of such cases, disease of the gall bladder was revealed by operation. With this additional possibility or "direct method" of demonstrating such lesions, a new impetus was given to this field of roentgenology. Further observations of the right upper quadrant by George, Leonard, Burnham and Kirklin resulted in the recognition of "indirect" or secondary evidence of cholecystic disease. Despite these continued advances, in no field of roentgenology is there greater uncertainty regarding the significance of findings than in the diagnosis of pathologic changes in the gall bladder.

The frequent incidence of disease of the gall bladder makes highly desirable any diagnostic method which will furnish a reasonable percentage of accurate results. It is of interest that a clinical diagnosis of cholecystic disease was made in 5 per cent of all cases observed in the Mayo Clinic in 1922. Also, of the last 100 necropsies at the Mayo Clinic, either macroscopic or microscopic evidence of disease of the gall bladder was found in 64 per cent. One of us (MacCarty) has examined more than 10,000 gall bladders, and found but seventeen "normal" specimens in a series of 5,000 cases.

In the light of our knowledge of microscopic pathology, and theories of infection and elective localization of invading organisms, it is doubtful whether any person more than thirty years of age can boast of possessing a normal gall bladder; at least it is much more commonly diseased than has been generally recognized. Consequently, assured before an examination of the support of the pathologist and usually of the surgeon, the roentgenologist needs only to discover a sign consistent with the presence of cholecystitis, and his percentage of correct diagnoses will be exceptionally high. Owing to the high incidence of disease of the gall bladder, a negative roentgenologic examination of the stomach, duodenum, and urinary tract in cases of upper abdominal complaint is very suggestive of disease of the gall bladder, even if the roentgenologic examination of that organ is negative. No doubt these circumstances often tempt the roentgenologist to make a diagnosis of disease of the gall bladder when his evidence would otherwise be highly inconclusive. Diagnoses based on such possibilities are, of course, unscientific, and only roentgenologic evidence which can be substantiated by pathologic changes should be considered.

In an effort to determine the significance of the "direct" roentgenologic signs of disease of the gall bladder, by comparison with the surgical and pathologic findings, a study was made of 2,500 cases referred during the last year to the Section on Roentgenology at the Mayo Clinic, for examination of the biliary tract.

TECHNIC OF EXAMINATION

The patient comes for examination in the morning, having had 2 ounces of castor oil at 4:00 P. M. the previous day, a saline

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enema the night before, and a liquid diet for twelve hours. This preparation, which varies from that of many observers, is adhered to for certain definite reasons. In the early cases in this series, in an effort to determine a suitable method of preparing patients, various cathartics were used, but results, as observed on the films, did not show a distinct advantage from using any particular cathartic, save perhaps the A.B.S. and C. pill; these pills seemed to cause slightly less gas than the other cathartics. The disadvantage, however, of any of the milder cathartics is that, if the patient is habituated to the various remedies for constipation, his preparation is likely to be unsatisfactory. Consequently, as most patients desire to have their examination completed as quickly as possible, a somewhat drastic cathartic has been chosen, which may be depended on for fairly satisfactory results. The enema is ordered at night, since the patient ordinarily cannot administer it without introducing a large amount of air, and less gas is observed in the films than if it is administered in the morning preceding examination.

Four or more roentgenograms are made with the patient prone, and the entire area from just below the iliac crest to the ninth rib is radiographed by allowing the areas exposed to overlap each other. A 2-inch cone is used and the medium focus tube tilted ten degrees toward the head. The distance, 24 inches, 50 milliamperes, and the time, 2.5 seconds, are maintained as constant factors, while the kilovoltage (machine reading) is varied from 43 to 56 according to the size of the patient. The patient must suspend respiration; on this factor depends the success of the exposure, for the least motion is fatal to the demonstration of delicate shadows. Much time and many films will be saved if the patient is instructed when and how to breathe before making the exposure. Patients are instructed to stop breathing at the end of expiration, because the average patient can hold his breath more easily then.

Films and plates must be of the best quality since it is impossible to delineate fine shadows in imperfectly exposed negatives. Our experience with the Bucky diaphragm for primary films has been disappointing and we have discontinued using it for that purpose. The distance between the patient and the film, necessary with a Bucky diaphragm, is sufficient to render detail inferior to that of contact films. For films to illustrate the secondary signs, however, the Bucky diaphragm has a distinct advantage.

INTERPRETATION OF FILMS

When a satisfactory film has been secured the shadows of the liver and kidney must first be differentiated. A third shadow, anywhere between the tenth rib and the iliac crest, may represent the gall bladder. Its most common location is just below the twelfth rib, where it projects below the edge of the liver as an elongated and rounded shadow of increased density, on which the shadow of the kidney is often superimposed. A suspicious shadow must be distinguished from no less than fourteen possible similar shadows. The most common error is to mistake the rounded edge of the lower pole of the kidney for a gall bladder. The average gall bladder, however, is much smaller than the average kidney, and the shape and indentation at the pelvis should aid in differentiating them, but if the gall bladder is distended, differentiation is sometimes difficult. In no case should a diagnosis be attempted unless the shadows of the liver and kidney can be identified. The outline of the upper pole of the kidney where it rounds into the pelvis may very closely simulate the shadow of the gall bladder, and in films of less than average photographic quality, differentiation is indeed difficult. Both borders of a gall-bladder shadow should be seen, whereas frequently only the medial side of the upper pole of the kidney will appear. The shadow of the gall bladder in this area may coincide with that of the upper pole of the kidney, but the area occupied by the combined shadows will be of greater density

than that of the portion of the kidney surrounding it.

Often a deceptive area of increased density is produced where the shadows of the upper pole of the kidney and the lower border of the liver overlap. The resulting shadow tends to be more transverse than the usual shadow of the gall bladder, and, by tracing the outlines of the liver and kidney, the apparent artefact should be discovered. Occasionally a deceptive shadow is cast by a prominent quadrate lobe of the liver, and the accompanying fissure, which runs up from the curved margin of the lobe and closely simulates the outline of a gall bladder. When compared with the shadow of the adjacent portion of the liver, the density will be the same, whereas if the suspected shadow was due to a gall bladder, there would be an increased density of this area, owing to the superimposition of this organ on the liver. In a few cases we interpreted an elongated shadow as a diseased gall bladder. At operation, the organ was found to be normal, but there was considerable hepatitis in the bed around it, which, no doubt, was largely responsible for the shadow.

Sometimes the shadow of an unusually broad twelfth rib overlapping the border of the liver may produce a suggestive area of increased density. Close inspection, however, should prevent this mistake. A confusing shadow is occasionally cast by the margins of the uncalcified cartilages of the ribs. If the film is observed obliquely and the curved shadow traced carefully, it will be seen to coincide with the line of a rib, and usually a similar shadow, caused by the border of adjacent cartilages, may be distinguished above and below the doubtful line. If there is an isolated area of calcification in the cartilage, delineation of the rib line is simplified.

Food within the antrum of the stomach, duodenum or small bowel produces a deceptive area of increased density. These areas are often mottled and closely simulate a gall bladder filled with translucent stones; they may be eliminated by careful preparation of the patient, and on second examination the shadows will probably have moved or changed in contour and appearance. The similarity to the gall bladder of a shadow produced by food within a haustrum of the colon has been noted by many observers; this may also be eliminated by preparation of the patient. Certain observers prefer to examine their patients without catharsis or limited diet, believing that the shadows will be less confusing without the gas produced by cathartics and enemas. We believe, however, that the annoyance which gas may occasionally produce is less confusing than the multitude of shadows caused by the contents of the bowel when a patient is examined without preparation.

In the plates of thin subjects we have often observed a shadow of increased density crossing the kidney shadow and other shadows, in a vertical direction, probably due to the rectus abdominis muscle. Unless well defined, it may closely simulate the shadow of a gall bladder. A pendulous breast, which has not been elevated during the upper exposures, may add a confusing shadow. Adhesions following operation, especially those involving loops of bowel or omentum, may produce shadows not unlike that of the gall bladder. In several instances, in which the patient was known to have had a cholecystectomy, we observed shadows typical of those cast by a diseased gall bladder. A curved shadow simulating the fundus of the gall bladder may be produced by small amounts of gas in the colon or hepatic flexure. Such a shadow is hard to differentiate, and it will be necessary to trace the course of the colon. The area above the curve is not of increased density, as it would be if the gall bladder were superimposed. If the patient is reexamined the shadow will be seen to have disappeared with the gas. It is perhaps unnecessary to mention the artefacts produced by abrasions, scratches and finger marks on the film. They are, however, often misleading to the careless observer.

The shadow of a gall bladder, we believe, is not produced merely by thickening of the wall of the organ. We have been able, in certain instances, to see a shadow which we believed to be a gall bladder, and found at operation that the gall bladder was thin-walled and contained thin bile. In other instances we have failed to see a shadow when the gall bladder was thickened and contained thickened bile. This would seem to indicate that the thickening of the wall is not alone responsible for the resulting shadow, and to suggest that the bile must play a considerable part in its production. Experiments by various observers have demonstrated that it is impossible to differentiate the X-ray densities of normal and abnormal bile. In view of these facts there is no apparent reason why the normal gall bladder should not cast a shadow as often as the diseased organ. The relative size and amount of fluid contents also influence the production of the resulting shadow.

It is customary to associate thick (increased viscosity) and highly colored bile with increased X-ray density. A short series of experiments on bile removed from various gall bladders immediately after operation revealed some interesting facts in this connection. Seemingly, the less viscid light-colored bile was more opaque to the X-rays than the darker, more viscid specimens. Our experiments so far have been limited, and we have not as yet attempted to formulate conclusions.

The roentgenologic demonstration of gallstones establishes a conclusive diagnosis, but unfortunately in only a moderate percentage of cases are the stones disclosed by the roentgen ray. The shadows of stones may be found at any point from the ninth rib to the upper pelvis, and from behind the vertebræ to the lateral abdominal wall. The number visible is no clue to the total number in the gall bladder and ducts, for one or all may be seen. Usually they may be differentiated by the typical shadow, less dense at the center than at the periphery, but it is difficult to distinguish atypical shadows from shadows that may be cast by: (1) single stones in the kidney, or multiple stones associated with hydronephrosis, and calcification in a tuberculous kidney; (2) calcification within the adrenal gland; (3) calcified rib cartilage; (4) articulated transverse processes of the lumbar vertebræ; (5) calcification in the tip of a transverse process, or an apparent shadow due to the obscuring of part of the process by the psoas muscle; (6) calcified mesenteric glands; (7) calcified areas within the liver; (8) calcification in the lung or pleura; (9) a calcified psoas abscess; (10) phleboliths in the skin or abdomen; (11) food or gas in the bowel; (12) barium in the bowel or appendix; (13) growths on the skin, and (14) artefacts in the film or screen.

INDIRECT EVIDENCE

Various observers have described certain indirect signs of disease of the gall bladder, consisting of (1) deformities of the antrum of the stomach, duodenal cap and second portion of the duodenum supposedly produced by a distended gall bladder, (2) deformities of the pyloric end of the stomach, duodenum and hepatic flexure, produced by adhesions between these structures and the gall bladder, and (3) certain referred spastic phenomena in the stomach, such as pylorospasm, delayed motility and cardiac regurgitation. With the recognition of these indirect signs, the direct signs of disease of the gall bladder became of decreasing importance in the minds of many observers. There are, however, certain phases of this transition which cannot be ignored. Before the utilization of the indirect signs many investigators claimed a high percentage of correct diagnoses, based on direct evidence alone. Leonard asserted that direct signs are present in but one-third of the cases, and that two-thirds of his diagnoses are based solely on indirect signs. There is, thus, a great discrepancy between these percentages and the high percentages of correct diagnoses made previously on the direct signs alone. Case has found that in a series of 350 cases the indirect signs were present in 88 per cent.

Inasmuch as we have undertaken to follow the indirect evidence in but a few of our cases, we are not prepared to discuss the definite value of these roentgen signs. There are, however, certain explicit reasons why we cannot attach a great deal of importance to them, or consider them more than corroborative of disease of the gall bladder. In this stand we have the support of George and Leonard, who say, "If the entire examination reveals only one minor type of indirect evidence, such as a suggestive pressure defect on the duodenum, then only a presumptive diagnosis can be made, such as 'the evidence is consistent with gall-bladder disease.'" Those who attach major importance to indirect signs, generally regard the semilunar deformity of the duodenum or gastric antrum, explained on the basis of a distended gall bladder, as the foremost indirect sign of a diseased gall bladder. Observations at operation and at necropsy show that the normal gall bladder varies so markedly in size that it is very difficult to decide when the organ is distended beyond normal limits. The majority of gall bladders examined by the surgeon fall into this class, or are contracted in size due to chronic disease. The number of markedly distended gall bladders, as seen by the surgeon and pathologist, constitute less than 10 per cent of the cases. In view of these facts it seems impossible to conclude from a roentgenogram whether a normal or diseased gall bladder is responsible for the resulting deformity, except in the 10 per cent just described. Case, in discussing Burnham's paper and commenting on this sign, says, "I feel that this [indentation of the duodenum] does not prove pathology, but only suggests it, and I am certain that a normal gall bladder can produce it."

Deformities of the duodenum and hepatic flexure, explained on the basis of adhesions between these structures and the gall bladder, constitute a very common basis for the diagnosis of disease of the gall bladder by the indirect signs. Adhesions sufficiently dense to deform or displace the duodenum or hepatic flexure are extremely rare in the experience of those accustomed to palpate deeply while screening. According to George and Leonard, deformities due to adhesions become most marked when the stomach and duodenum are full. Inasmuch as both of these structures are completely filled by manual palpation during our routine screen examination, deformities are not likely to be overlooked. The diagnosis of filling defects and deformities from films alone is hazardous and unscientific, as many of these pseudo-defects are completely eliminated by a systematic screen examination. At the Clinic last year in 486 cases in which negative roentgen examination of the stomach and duodenum had been made, disease of the gall bladder was found at operation. The diagnosis of duodenal ulcer was also made by the roentgenologist in 969 cases, in 538 of which operation was performed. The deformity of the duodenum, interpreted by the roentgenologist as indicative of ulcer, was found to be due to disease of the gall bladder and adhesions involving the duodenum, in 11 cases (2 per cent). A review of 1,743 cases of cholecystitis in which operation was performed at the Mayo Clinic in the last two years (Table 1) shows that adhesions around the gall bladder were present in 29.7 per cent. These adhesions varied from a thin fibrous band to a dense fibrous mass. Being generous, however, and granting that all of these adhesions were sufficient to deform adjacent organs, the indirect roentgen signs based on such deformities could not be of value in more than 30 per cent of the cases. Lahey, in a limited number of doubtful cases, was influenced by the roentgen-ray diagnosis, which was based on various signs, such as fixation of the pylorus to the right, filling defects of the duodenum, or a shadow of the gall bladder. According to his experience, "operative procedures undertaken largely on such roentgen-ray evidence, yield distressingly unsatisfactory results, and the gross patho-

logical findings are extremely disappointing."

Pylorospasm, retention of barium in the ampulla of Vater, and perhaps cardiac regurgitation, may occur as accompaniments of disease of the gall bladder, but in such a small percentage of cases as to afford inconspicuous evidence. In view of the foregoing and our limited experience with indirect signs, we do not believe that they are entitled to the importance that has been given them. In an effort to determine more fully the definite value of this evidence, we are preparing to study a series of cases, utilizing indirect signs in addition to the direct.

TABLE 1

Adhesions found around the gall bladder at operation

	Operations	Adhesions	Per cent
Cholelithiasis	1,131	248	21.9
Cholecystitis	612	271	44.2
Total	1,743	519	29.7

THE VALUE OF STATISTICS WHEN STATED IN PERCENTAGES

TABLE 2

Comparison of roentgenologic and operative findings

Cases examined	2,500
Negative roentgenologic diagnosis	1,572
Diagnosis of pathologic condition of gall bladder	386
Diagnosis of gallstones (6 per cent)	152
Re-ray requested	459
Diagnosis not possible	124
Report "suggestive of disease"	18
Patients operated on	500
Surgical cases with definite roentgenologic diagnosis	410
Surgical cases with indefinite roentgenologic diagnosis	90

Surgical cases with definite roentgenologic diagnosis
(Gallstone cases included)

Roentgenologic diagnosis	Patients operated on	Negative at operation	Pathologic at operation	Correct diagnosis, per cent
"Negative"	241	42	199	17.4
"Pathologic gall bladder"	169	5	164	97.0

Gallstones

	Cases
Found at operation	226
Diagnosed by X-ray	87
Not diagnosed	139
Found by X-ray	38.4 per cent

The translation of statistics (Table 2) concerning the X-ray examination into percentage values is a source of much confusion, misunderstanding and controversy. There are divers ways of arriving at such percentages, all of which are at least superficially plausible, and most of which have some basis in reason, yet they lead to widely different results. In computing percentage values two factors are essential: (1) only definite roentgenologic reports should be considered (reports of "indeterminate" or "suggestive" or "suspicious shadows" should be disregarded, since roentgenologic suspicion is no better than clinical suspicion), and (2) the condition of the gall bladder should be determined by surgical exploration or microscopic examination, or both. The surgeon may believe that a diseased gall bladder is normal and decline to remove it; if the roentgenologist has made an affirmative report, his percentage of correct diagnoses is thus lowered. Likewise, the pathologist may err, either positively or negatively, but from his court there is no appeal. Computations are designed to answer questions, as follows:

1. What is the value of an affirmative roentgenologic diagnosis in cases examined? Of the 410 surgical cases with a definite roentgenologic report, a diagnosis of lesion of the gall bladder was made in 169; in 164 of these the diagnoses were confirmed by the pathologist; in five the condition was believed by the surgeon to be normal. Thus the roentgenologist made a correct positive diagnosis in 97 per cent of the 169 cases, and this might seem to justify congratulation, but it must not be taken too seriously, as further analysis will show.

2. What percentage of lesions of the gall bladder will be correctly diagnosed by the roentgenologist? Of 363 cases in which lesions were found at operation, 164 (45.1 per cent) had been correctly diagnosed by the X-ray. This is our most common method of computing diagnostic percentages, and we believe it to be a fair one. In this instance the method may or may not favor the roentgenologist, because there were 77 additional cases with lesions of the gall bladder, in most of which the roentgenologist's request for re-examination was not granted, and in the others, the roentgenologic report was indecisive. All such cases were excluded in determining percentages.

3. What is the value of a negative roentgenologic report in cases of suspected disease of the gall bladder? Of 241 cases

reported as negative by the roentgen ray, only 42 (17.4 per cent) were considered normal by the surgeon, and not removed, while 199 (82.6 per cent) considered as abnormal, were removed and the operative diagnosis confirmed by the pathologist.

4. What percentage of gallstones can be correctly diagnosed by the roentgen ray? Among 226 cases of gallstones found at operation, the roentgen ray revealed stones in 87 (38.4 per cent). This percentage is higher than that of any other series previously investigated at the Clinic. The 87 cases are included with the 164 proved cases of disease of the gall bladder. Certain examiners have used a different method in determining this percentage. They compare the number of instances in which stones were shown by the X-ray with the total number of cases examined, and then compare this percentage with the percentage of stones shown by large necropsy statistics. Extensive necropsy statistics indicate that about 6 per cent of all persons have stones. It may be noted that of the 2,500 cases examined, from which our smaller proved series is derived, stones were discovered by the roentgen ray in 6 per cent. Apparently this is a perfect score, but its fallacy is shown by the fact that the roentgen ray revealed stones in only 87 of 226 cases in which stones were found at operation.

5. What is the net efficiency of the roentgen ray, that is, its combined affirmative and negative diagnostic value in a series of normal and abnormal cases? This seems to be a fair question, but it cannot be answered satisfactorily in terms of percentage. For example, if the 97 per cent of correct affirmative diagnoses be added to the 17.4 per cent of correct negative diagnoses, and the sum divided by two, the result is 57.2 per cent. Further, the 42 correct negative plus the 162 correct affirmative cases constitute 50.2 per cent of the 410 cases definitely reported. Neither percentage has any real significance. The 17.4 per cent of correct negative diagnoses, the 45.1 per cent of diseased gall bladders revealed by the roentgen ray, and the 38.4 per cent of cases of gallstones demonstrated, are all that appear to have any practical value. The percentage of correct negative reports is so small that it is practically worthless, and it was fortunate for most of these patients that negative roentgenologic findings were not considered by the clinician and surgeon to bar exploration.

The 45.1 per cent of cases of gall bladders (including those of stones) revealed by the roentgen ray to be diseased, and the 38.4 per cent of cases of gallstones discovered, are somewhat more impressive. Notwithstanding, less than half the number of cases of diseased gall bladders were revealed by the roentgen ray. The net impressions from this series are that an affirmative roentgenologic diagnosis is highly reliable, but that such diagnoses can be made only in a minority of the cases, and that a negative report is worthless.

THE PATHOLOGIST'S REPORT ON 343 OF THE 500 SURGICAL CASES

All of the 343 patients had had one or more pre-operative X-ray examinations; 155 (45 per cent) had had a positive diagnosis of a pathologic condition, and 188 (55 per cent) a negative diagnosis. The specimens were studied with regard to the degree of the disease, the length and diameter of the organ, the thickness of the wall, the presence of stones, and the presence of the pathologic entity which has been called "strawberry gall bladder." The results of this analysis are shown in Tables 3 to 6.

TABLE 3

Gall bladders graded grossly on a scale of 1 to 4

	Cases	Per cent
(Grade 1)		
Positive X-ray diagnosis	49	34.0
Negative X-ray diagnosis	84	58.3
Suggestive positive X-ray diagnosis	11	7.6
	144	
(Grade 2)		
Positive X-ray diagnosis	53	61.6
Negative X-ray diagnosis	28	32.5
Suggestive positive X-ray diagnosis	5	5.8
	86	
(Grades 3 or 4)		
Positive X-ray diagnosis	45	48.9
Negative X-ray diagnosis	46	50.0
Suggestive positive X-ray diagnosis	1	1.0
	92	

The normal as well as the abnormal gall bladder varies greatly in length in different individuals, and varies normally in each individual with the stages of function, but it may be said that the normal organ is about 6 to 7 cm. in length, and from 2 to 3.5 cm. in its greatest transverse diameter.

TABLE 4

Relation of the size of the gall bladder to visibility in the roentgenogram

	Cases	Per cent
Gall bladders more than 8 cm. in length		
With positive X-ray report	48	48.9
With negative X-ray report	50	51.1
	98	
Gall bladders between 4 and 8 cm. in diameter		
With positive X-ray report	3	33.3
With negative X-ray report	6	66.6
	9	

Thickness of the wall of the gall bladder has been considered a possible factor in the production of X-ray shadows (Table 5). The wall of the normal organ is from 1.5 to 3 mm. thick. The thickness is often increased by a deposit of fat in the subserosa, but there is no good evidence that this is not a normal condition. Certainly it is not an index of a pathologic condition of the mucosa, although it robs the organ of the bluish appearance which has been described by surgeons as the color of the normal organ.

TABLE 5

Influence of thickness of gall bladder, and of presence of stones on roentgenologic visibility

	More than 4 mm. thick (definitely pathologic)	3 mm. thick with stones	3 mm. thick without stones	3 mm. thick with or without stones
Number of patients with positive X-ray report	65 (50 per cent)	37 (63.7 per cent)	19 (38.7 per cent)	56 (52.7 per cent)
Number of patients with negative X-ray report	64 (50 per cent)	21 (36.2 per cent)	30 (61.2 per cent)	51 (47.2 per cent)

From these data an estimate of the actual clinical value of the "direct" roentgenologic signs in the diagnosis of pathologic conditions in the gall bladder may be made.

TABLE 6

Correct diagnosis

	Per cent
Correct positive diagnoses in Grade 1 gall bladders	34.0
Correct positive diagnoses in Grade 2 gall bladders	61.6
Correct positive diagnoses in Grades 3 or 4 gall bladders	48.9
Correct positive diagnoses in gall bladders more than 8 cm. in length	43.9
Correct positive diagnoses in gall bladders more than 4 cm. in diameter	33.3
Correct positive diagnoses in gall bladders with walls more than 4 mm. thick	50.0
Correct positive diagnoses in gall bladders (with stones) with walls 3 mm. thick	63.7
Correct positive diagnoses in gall bladders (without stones) with walls 3 mm. thick	38.7
Correct diagnoses of stones	98.6
Correct diagnoses of pathologic gall bladders in specimens containing stones	56.8
Correct diagnoses of pathologic gall bladders (strawberry type)	47.8
Average	52.9
Incorrect diagnosis	
Failure to find pathologic conditions in gall bladders (Grade 1)	58.3
Failure to find pathologic conditions in gall bladders (Grade 2)	32.5
Failure to find pathologic conditions in gall bladders (Grades 3 or 4)	50.0
Failure to find pathologic conditions in gall bladders 8 cm. long	51.1
Failure to find pathologic conditions in gall bladders 4 cm. in diameter	66.6
Failure to find pathologic conditions in gall bladders more than 4 mm. thick	50.0
Failure to find pathologic conditions in gall bladders (with stones) 3 mm. thick	34.4
Failure to find pathologic conditions in gall bladders (without stones) 3 mm. thick	61.2
Incorrect diagnoses of stones	1.4
Failure to recognize pathologic conditions in all gall bladders with stones	40.7
Failure to recognize a pathologic condition in organs showing a definite pathologic entity called the "strawberry gall bladder"	44.9
Average	44.6

Thus it may be seen that in this series of 343 cases, the roentgenologist has been able to make a positive report of disease in 52.9 per cent, and a negative diagnosis in 44.6 per cent when there was evidence of mild or extreme grades of disease.

The study of both these series of cases raises the question of whether the results warrant the time and expense required for roentgenologic examination. All the gall bladders removed at operation were examined by the pathologist and found to be diseased. Many of them were graded 1, with only microscopic evidence that they were abnormal. The rarity with which normal gall bladders are found by pathologists has been mentioned. These facts suggest doubt whether a gall bladder demonstrable by the roentgen ray, and with a minimal amount of disease at operation, is respon-

sible for the patient's symptoms. Only the result of operation can determine this point.

On the whole, we do not wish to condemn roentgen-ray examination as a means of diagnosis, but rather to point out its fallacies and limitations, for any diagnostic method which gives an accuracy of 50 per cent is worthy of consideration in selected cases.

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ABSTRACT FROM CURRENT LITERATURE

BULL, P.: DISAPPEARANCE OF TUBERCULOUS PERITONITIS EIGHT DAYS AFTER THE USE OF ELEVEN CGM. OF RADIUM. *Tubercle*, 1923, IV, 450.

Bull, of Christiania, reports the case of a boy, aged three years, who came to hospital with the diagnosis of tuberculous peritonitis. The lower abdomen and right testicle were swollen. On examination a malignant tumor of the testicle with abdominal metastases was diagnosed and an exploratory laparotomy done. Passages were made in different directions in the tumor mass and nine radium tubes inserted, containing altogether 11 cgm. of radium, without lead filters. The tissue removed from laparotomy showed characteristic tuberculous structures. Eight days later the tumor mass had vanished completely. The boy died eight months later from a mastoid abscess and autopsy showed that although the radium had not altogether banished tuberculosis from the abdominal cavity, its effect on the tuberculous changes was so great and rapid as to astonish all who followed this case.

Bull states that had he not diagnosed malignant disease and regarded this case as practically hopeless, he would not have dared to give a small child such a large dose of radium as 11 cgm. without a lead filter. But the completeness with which this severe tuberculous peritonitis disappeared in eight days is amazing, and Bull cannot explain it as being anything but the result of the radium treatment.

DEEP ROENTGENOTHERAPY IN BENIGN HYPERTROPHY OF THE PROSTATE[1]

By GEORGE F. THOMAS, M.D., and ROY G. GILES, M.D., CLEVELAND

BENIGN hypertrophy of the prostate is a frequent cause of disability in men over fifty years of age. The mortality rate directly or indirectly attributable to it is high. The only method of treatment generally accepted at the present time is surgical. The results obtained in selected cases by skillful experienced surgeons using the modern pre-operative measures are excellent, so excellent, in fact, that under these conditions prostatectomy is admittedly the proper procedure in those cases that require operation.

There are, however, many patients with symptoms resulting from hypertrophy of the prostate who for one reason or another will not submit to prostatectomy; there are many with symptoms hardly sufficient to warrant it; and furthermore, there are patients who for various reasons are left in the category of unselected cases, not fit for the radical operation.

Most of these patients need, and would welcome, an efficient non-operative method of relief. We have obtained very beneficial results from roentgen radiation in some of these cases, and are led to believe from our own experience and from a survey of the literature, that in high voltage roentgen therapy we have a very valuable method not only of affording relief from symptoms in most of these cases, but also of diminishing the size of the prostate.

It is essential, however, that the possibilities of this method for good or harm be carefully evaluated, lest it be discredited by the untoward result of indiscriminate employment. Such an evaluation will require the study of a large series of cases and observations covering a period of years. Such a study has not yet been made, as far as we can find out from the literature. It obviously will be difficult for one man to acquire a large series until the method is more generally accepted as a rational method of treatment. In the meantime, reports of isolated cases will blaze the way.

This brief survey of the subject is, therefore, frankly presented with the purpose of arousing more interest in, and critical discussion of, a method which we believe is entitled to more consideration on the part of the medical profession than it has apparently received.

It is generally agreed that there are two pathological types of benign hypertrophy of the prostate that give rise to urinary symptoms in men beyond fifty years of age. The more common type consists of a disproportionate increase in the size of the prostate due to the formation within the organ of tumor-like masses which are composed of tissue whose elemental structure is identical with the gland itself. According to most pathologists this is a true hyperplasia of the glandular tissue. The other type consists of a diffuse growth of connective tissue with islands or strands of smooth muscle. The fibrous growth may be fairly dense in structure. Cases of this type are not common. Those in which there is a distinct myoma are rare. These cases may be complicated by the presence of stones or calcified matter in the substance of the gland.

Analysis of statistics shows that in selected cases with modern pre-operative care and an experienced surgeon there is a mortality rate of from 3 to 7 per cent. Under unfavorable circumstances the mortality may be as high as 20 per cent. Young (1) gives the mortality rate of 1,049 cases operated upon by him during the past 20 years as 36, or 3.44 per cent. Whiteside (2) in 1915 reported a mortality rate ranging from 3 to 26 per cent in a series of 1,423 cases collected from the literature. Barney (3) recently reported a general mortality of 18.8 per cent in 250 prostatectomies. Carisi (4) states that with the per-

[1]Read before the Radiological Society of North America, December, 1923, at Rochester, Minnesota.

ineal method the mortality was 15 per cent. About 50 per cent were regarded as cured.

Deaver (5) reports that 72 per cent of the patients operated upon in his clinic are living and well two years following operation and that 8 per cent are living but not completely cured. That is, at the end of two years 20 per cent are dead, and 8 per cent of the living are not cured.

The average case is admittedly a poor surgical risk. He comes to the surgeon as an acutely ill patient and the acute condition is superimposed upon an old pathological process which usually has existed for years. This old process is frequently accompanied by cardiovascular and renal changes. The resistance to external infection is markedly reduced and the power of recuperation is often almost *nil*. It is unfortunate that all of these patients cannot avail themselves of experienced urological service. The sudden complications and urgency of the condition in the average case make this impossible. In these unselected cases under these conditions we must expect a high mortality rate, as in other operations upon elderly people.

The post-operative complications and sequelæ require expert attention and skill. As the cause of death following prostatectomy in 147 cases, Deaver (5) reports the following: uremia, hemorrhage, shock, sepsis, cardiovascular changes, pyelitis, pyelonephrosis, asthenia, pulmonary embolus, diabetes, extravasation of urine, acute dilatation of the stomach, air embolus and paresis.

This brief survey of the surgical literature on prostatic hypertrophy shows that prostatectomy with its dangers, its complications, and its sequelæ remains a serious major operation in spite of the improved technic. There is a field for other methods of treatment. Investigation along this line is indicated. A review of the literature on roentgen therapy of the hypertrophied prostate shows that comparatively little work has been done on this subject, although the results reported are generally favorable.

The application of X-radiation to the enlarged prostate dates from 1902 when Robarts (6), of St. Louis, reported improvement in three cases. During the same year Gautier (7), of Paris, reported great relief of the symptoms with a diminution in the residual urine. Three years later Carabelli and Luraschi (8), in Italy, reported two cases completely cured after one year, and Moszkowicz (9), in Vienna, reported three cases relieved of their symptoms. In 1920, Haret (10), in France, and Oppenheimer (11), in Germany, almost simultaneously offered the opinion that X-ray therapy is the logical treatment to relieve symptoms where glandular hypertrophy alone is present. Stern (12), in 1921, reported five-year cures of two very severe cases. He also called attention to the difficulties encountered in the more severe cases where sacculation and decreased bladder tone interfered with an ideal end-result. Heuser (13) reports very favorable results where the hypertrophy of the prostate is due to parenchymatous and glandular hypertrophy and in true adenoma. However, he thought roentgen therapy of little benefit in hypertrophy of the connective tissue if the nucleus was hard and cicatrized. Guilbert (14), in 1922, reports two cases who had been condemned to the use of the catheter for life, who could follow their occupation six weeks after deep therapy treatment.

Recent papers on radiation treatment of enlargement of the prostate have been published by Philips (15) and Stevens (16). Philips reports excellent results in a series of 25 cases representing all types and stages of prostatic urinary obstruction. Stevens states: "In 30 out of 33 cases our treatment met with success, i.e., the retention was relieved, likewise the frequency, the urgent painful urination, the bleeding, the pain in the perineum, etc.; and upon examination it was found that in 3 cases the gland had returned to normal, and in 27 cases it was reduced on the average to one-third its size as determined in the beginning and instead of being hard was soft to the touch." Of the three unsuccessful cases,

one death was attributed to cerebral hemorrhage, and one to cardiac failure. The third case was a true radiological failure, and the pathological diagnosis in this case was adenoma with fibrosis.

Even this very brief review of the literature on the treatment of prostatic hypertrophy shows unquestionable progress in the results attained by radiation. Improvement was obtained in some of these cases which were treated with little or no filter when little or nothing was known of the correct methods of delivering high intensity depth doses. With the modern technic, with short wave-length, heavily filtered X-rays, we can produce more effect on the prostate with relatively less on the superficial tissues. This simplifies the treatment considerably and may eliminate some of the deleterious effects claimed to have been produced by the old technic with lower voltage. In the early cases we treated, where we used only a few millimeters of aluminum and a layer of leather for filtration, we found repeated doses over two or three fields necessary to obtain results, although the first series frequently alleviated the symptoms. If immediate relief was not obtained, surgical measures were usually resorted to.

That radiation does not produce adhesions, but on the other hand often cures or benefits pathological adhesions, is indicated by Stevens' case which was operated upon following radiation. He states that the gland was removed with much less hemorrhage and without more surgical difficulty than had the patient not been radiated. In previous years, some surgeons claimed that it was very difficult to control hemorrhage in cases operated upon after much X-ray exposure. There is reason to believe that the situation is altered by the improvement of technic in roentgen therapy. The necessary dose can be delivered to the prostate if necessary in one treatment, through anterior and posterior fields, without direct exposure over the perineal route of the surgeon.

In our recent cases we have used the following technic: 200,000 volts (peak); filtered through 1 mm. cu. and 1 mm. al.; anterior and posterior portals measuring 15 x 15 cm.; focal skin distance of 50 cm. Effective wave-length produced under these conditions according to Duane is .138 Å.U. Our 10 cm. depth dosage is about 40 per cent. Our erythema dose for one portal of entry when using these factors with our standard tube, is 520 ma. minutes. We give through the posterior area about one-half to two-thirds of the erythema dose and allow an interval of several days before giving the anterior area. We have not had our attention directed to a tenesmus or undue bladder discomfort in any of our cases treated over the pelvic region. We do not expect it. The situation is somewhat similar to that obtained in the X-ray treatment of uterine fibroids. Some of our uterine cases on questioning state they have a couple of days of increased frequency of urination, but no special discomfort.

Roentgenotherapy is beneficial in all forms of prostatic hypertrophy, especially in the more common soft glandular type where the adenomatous tissue prevails. The hard cirrhotic type, which fortunately is comparatively rare, does not respond so well to treatment. Undoubtedly the most favorable cases for X-ray therapy are the early or mild cases having reached only the first or second degree of hypertrophy, who come to their family physician complaining of occasional pain and discomfort in the prostatic region, with frequency of micturition, and possibly with slowness in starting the act of urination, and occasionally prostatic bleeding. The early mild cases as a rule will not submit to an operation.

Improvement in these cases is often perceptible within 24 hours following radiation treatment. Beneficial effects are first seen in improvement of the nycturia, and diminished frequency of urination. The residual urine is generally reduced 50 per cent, according to Pedersen (17), during the first week following treatment. Subsequently the pain, tenesmus and frequency

diminish progressively until at the end of three or four weeks the patient is usually quite comfortable. In an occasional case, although there may be quite marked subjective improvement, there is only slight reduction in the size of the gland. In the chronic cases of retention the results are sometimes tardy, whereas in the more acute cases the improvement is comparatively prompt.

In conclusion, we wish to summarize, as follows: Roentgen therapy has been sufficiently successful in cases reported in the literature and in our cases to justify its use in all cases of prostatic hypertrophy except those in which immediate operation is indicated.

It is the rational method to reduce the size of the gland when there is merely glandular hypertrophy. It is the logical method in the case of the old or feeble man who is already accustomed to the catheter life. The catheter proves only palliative; X-ray treatment often secures great relief and should be tried in all such cases.

The treatment is painless. In the hands of experienced roentgenologists it is free from danger. The mortality rate is *nil*. Even in the cases that are not cured no harm is done. Operation is still available.

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DISCUSSION

Dr. Newell (San Francisco): What struck me was this treatment from a front-and-back field. I have not treated any benign hypertrophies. We have once in a while some malignancies of the prostate to treat, and in those cases have usually been able to demonstrate metastases in the pelvic bones, or at least suspected them, because they usually come to that, and have treated the whole abdomen under those circumstances, and one can best cover them with an anterior and posterior field. I would like to ask the author what he thinks of the treatment through perineal effort. I have never used it, but may try it.

Dr. Trostler (Chicago): I want to agree with everything Dr. Giles has said with regard to this thing, and call your attention to the fact that this is a field that has been overlooked probably more than it should be. I have treated, not by the 200,000-volt method but by the medium voltage, 14 or 15 of these cases. Quoting purely from memory, I have one case that I treated five years ago, a man at that time 65 years of age, who is now well and comfortable; one case 52 years old, four years ago, now 56, who is now well and comfortable; another four years ago, who at that time was 62, so he would now be 66; two cases three years ago, one of them a man at that time in the early fifties. These men refused operation; the cases were all of the glandular type, and I have refused to take anything but the glandular type for treatment, because I believe that we should select our cases for roentgen therapy just the same as the surgeons do. Patients who have come to me with the fibroid type, I have refused to treat and induced them, even against their desire, to be operated on. I think if we will be as careful as that in this type of case, we will get results equally as good as the surgeon's. One of the great troubles with many of the radiologists has been, and I fear it is today, that they take all the cases that come to them. That method will throw roentgenology into disrepute, just as it was in the early days when we thought the X-ray was a cure for everything. I want to plead with you to select your cases carefully; you

will get results if you do and you will benefit the science of radiology.

Dr. Ross (Omaha): I enjoyed the Doctor's paper and was glad to have him bring forth the fact that these large prostates are satisfactorily treated by the X-ray only. I want to differ with him in the fact that I do not believe it is necessary to use the high voltage, inasmuch as it has been my experience, the same as Dr. Trostler's, that we get results with less voltage. On those cases I have used 135 to 148. Before commencing the treatment of those cases, I try to make sure there are no local foci of infection such as exist in the seminal vessels, or anything that will prolong or retard the complete recovery of the case. I think it is as necessary to follow up the treatment by local examination in treating those cases as it is in tonsil cases, and not attempt to cure it all with one knock-out dose, so to speak. It is of such a nature that if it is a recent, acute affair, it will subside rather quickly and rather rapidly. If you happen to get hold of a chronically enlarged case where there is much fibrosis, it is necessarily slower and your treatment should be repeated at wider intervals, giving a longer time for absorption to take place, and I think we should explain to patients that they should come in for examination every two or three weeks after the first urgent symptoms are relieved. It has been my practice also to make sure that the patient's bladder was empty and that he had taken an enema before giving him a treatment. Whether that is of any particular value or not, I do not know. Anyhow, he should not have a full bladder or full rectum, inasmuch as I have given both the posterior and frontal exposure.

Dr. Giles (closing): I wish to thank these gentlemen for their discussion of this paper at this late hour. I heartily agree with what Dr. Trostler has said. If we treat these cases promiscuously, irrespective of the type of the gland and the symptoms in all cases, the treatment will be disappointing and will bring discredit upon the method. In the past we have treated cases with the lower voltage, but it has been our experience that better results are obtained with the higher voltage X-rays. It is true that the majority of the non-malignant conditions can be cured with lower voltage radiation, but we believe the short wave length X-rays are desirable in all these cases, because the same results are accomplished quicker with less inconvenience, and with little or no risk of skin damage in the hands of the well-trained roentgenologist. Furthermore, Pedersen, of New York, a urologist, stated in the *Journal of Urology* for March, 1923, that he had treated 70 of these cases, most of them prior to the war and only four or five since, and had been able to follow only 13 cases to check end-results. So that is usually the trouble; when these patients are relieved of their symptoms, they will not report for further observation. The cases we have treated with the deep therapy technic have had very satisfactory results. The first patient treated was given a comparatively light dose of high voltage X-rays and was advised to return in four weeks for further treatment. He was 76 years of age and had been having urinary symptoms, increasing over a period of several years. During the last three or four weeks before he came in for treatment, he was unable to void at all and had to be catheterized twice daily. Following treatment he required catherization only three or four times and states that he has to get up now only once or twice at night, which is much less than normal for him over a period of seven or eight years. He was relieved of all bleeding, pain, and frequency of urination.

SARCOMA OF THE BONE, WITH REPORT OF CASES[1]

By W. WALTER WASSON, M.D., DENVER, COLORADO

ANY disease with a mortality of only a few points less than 100 per cent, no matter how long it has been discovered, must still be classed among the unexplored. As such it is then open to general discussion, and it also follows that not any of us has a great deal of knowledge of the subject. If we can stimulate such a discussion we will bring about greater familiarity, investigation, and the saving of many lives. Since early diagnosis is still the key to the cure of any malignancy, then the radiologists of this country, and their frequent examination of masses of people, should hold the key to sarcoma of the bone.

Sarcoma, wherever found, is a connective tissue tumor, rapid of growth and very malignant. Its cells, which multiply rapidly, are held in a loose stroma, easily losing their attachments, and are carried by the blood stream, or the lymph, to some distant organ. It may also spread by direct extension. As a result of these properties, it is irregular of outline and heedless of boundaries.

Sarcoma of the bone is not especially different from sarcoma in any other location, having all the properties just described, with the addition of any specialized property of the periosteum. Being primarily a soft tissue tumor, it destroys the bone and breaks into the blood streams with which the bone marrow is richly supplied.

Sarcomatous tumors are given various classification according to their cell structure or any peculiar qualities. In general we speak of the small round-cell type, the spindle-cell, the giant-cell, and, in addition, sarcoma of the bone has the periosteal and the osteal types, owing to the involvement of the periosteum. The small round-cell and spindle-cell types arise in the middle medulla portion of the shafts, while the giant-cell rises from the medulla portion of the ends of the shafts and in neither case do they produce bone. They are soft tumors with small round or spindle cells, or a mixture of the two, embedded in a loose stroma. The giant-cell type consists of large giant cells in a poorly nourished stroma so that some of these cells farthest away from the blood stream are poorly supplied, become necrotic, and produce areas of necrosis. The cell attachment is of a different nature from the other two types in that these cells are not broken loose and swept into the blood stream. It is, therefore, not malignant in the sense of forming metastases. It has also been said that it may heal spontaneously. The osteal and periosteal varieties arise, as the name implies, from the periosteum or the adjacent tissue, spreading into the soft tissue as in the true periosteal, or into the bone as in the osteal type. Inasmuch as these tumors retain the special quality of the periosteum, there is some bone formation scattered through a soft-tissue tumor. There is, likewise, bone destruction as the tumor invades the cortex of the bone.

The radiograph will portray two changes in the bony structures—bone production or bone destruction. As it is possible to get excellent detail in our radiographs of the bones, we can then show the early changes in either bone destruction or bone production. Sarcoma may produce both of these changes, but there are many other conditions which may do the same thing, and many times do it in quite the same way. After a survey of many cases of infection and bone tumors, we come to the conclusion that sarcoma of the bone has no earmarks which are outstanding and differentiating it conspicuously from any other disease. It is quite important that the radiologist realize that this is true.

Since we find no radiographic qualities peculiar to the sarcoma we are forced, in making diagnosis from other tumors, to resort to the law of probabilities. Doctor

[1]Read before the Radiological Society of North America, San Francisco, June, 1923.

Baetjer has made quite a clear-cut analysis and has suggested that we study tumors, first, as to the origin; second, presence or absence of bone production; third, condition of the cortex, and fourth, as to invasion. With exception of rare diseases, as myeloma, sarcoma is the only malignant tumor arising primarily from the bone. Carcinoma is always secondary, involves the shafts where it is deposited from the blood stream, and may, therefore, be ruled out by a study of the clinical history and examination of the patient. A tumor of the periosteum likewise rules out carcinoma.

Our next important step is to differentiate a benign tumor from a malignant one. Benign tumors are usually cylindrical, growing slowly and expanding the cortex as they grow. There is very little bony destruction, and, as they grow slowly, there may be some production with a single exception of the giant-cell sarcoma. On the other hand, the malignant tumor is more apt to be spherical, or irregular in outline, destroying rapidly the bone as it advances, breaking through the cortex into the soft tissue. Fortunately many of the benign tumors are quite characteristic and easily differentiated from the malignant, such as the cysts, osteomata, exostoses, fibromata, etc.

Having decided that our lesion more closely resembles the malignant, we must now decide between malignant tumor, sarcoma, or myeloma or infection. Infection of the bone may come from without, involving the shaft or the ends of the bone by direct extension, or from within. Those coming from within are usually the most confusing. Infection is supposed to travel by way of the haversian canals, breaking through the cortex by bone destruction into the surrounding tissue. As such, it may leave areas of good bone and does not expand the cortex. It may either destroy or produce bone, according to its virulence and the reaction of the bony tissue to its presence. Unfortunately malignant tumors may do practically all of these things, and, in border-line cases, in so much the same way that it is almost impossible to differentiate them. Frequently a history of infection, or some laboratory test, will enable us to decide.

Let us now consider this subject from the radiologist's viewpoint. In any given case it is usually easy, with our present apparatus, to demonstrate a lesion, and, many times, one may readily decide as to the type of bone tumor or infection. Again, markings characteristic of any certain disease may not be outstanding and recourse must be had to the law of probabilities. This is nearly always disappointing and does not enable us accurately to differentiate malignancies from infections. It is only fair to the patient that we realize this uncertainty, and the hesitancy with which our surgeons operate upon these cases is proof of it.

Doctor Bloodgood has stated that there are no authentic cases of cure of sarcoma of the bone in the upper extremities and only 8 per cent in the lower. In spite of radical amputations there cannot, therefore, be much pleasure or enthusiasm in the diagnosis or study of these gross lesions. On the other hand, as yet, we have heard very little about the early lesions, and it seems that they have not been very often observed. As in the fight against malignancies in the other parts of the body, the early lesion should be our goal, and, with the ease with which the bone lends itself to radiographic purposes, the early lesion should be within our range of observation. If, as Doctor Bloodgood has suggested, every case with "localized pain in region of joint or bone should be looked upon with anxiety and should be followed at once by X-ray," we should gather considerable evidence of the earlier lesions. Our main consideration would then be, Is there a destructive bone lesion present? If we can decide this point accurately I doubt very much if the surgeon will care to mark time waiting for grosser evidence of malignancy or infection, and allow the patient to drift into the class of 100 per cent mortal-

ity. For such work the radiologist must strive for radiographs showing the most excellent detail of the bony architecture. In the early lesion, or in the grosser lesion, the process may have extended farther than the first study of our plates would indicate. As an aid in such determination, I would suggest the use of the pinhole picture, as described by me in a previous communication. It has been my experience that we tend to be too conservative, and in the presence of a positive Wassermann reaction, or some other finding, allow a lesion with evidence of bone destruction to pass beyond the operative stage. I can recall certain cases where I was in doubt, and allowed such clinical evidence to increase my lack of assurance and, thus, indirectly affect the surgeon. We must be certain of our destructive lesion and give the surgeon this information without reservation.

DISCUSSION

Dr. Maximilian John Hubeny (Chicago): I was impressed by two things: one was the emphasis of the author on the early recognition of malignancy. It appears to have been the custom in the past to seriously consider malignancy in such organs as the breast, uterus, prostate, and stomach, while early bone lesions rarely prompted a consideration of malignancy. It is a well-established fact that cure or palliation are in direct ratio to the early institution of remedial measures; therefore, it is important to recognize the lesions as early as possible.

The other thing that impressed me was the candor of the essayist. It is oftentimes impossible to definitely recognize the nature of a bone lesion. I have been very much confused and sometimes chagrined by tumors that involved the medullary canal, because I did not know what I was dealing with. Of course, a history of a primary malignancy is helpful, or if multiple osseous lesions are present one may be guided in the right direction; however, it is very difficult and often impossible to differentiate between a localized neoplastic osteitis fibrosa, central spindle-cell sarcoma, chondrosarcoma, enchondroma and crateriform giant-cell sacroma. A bone cyst rarely extends into the epiphysis through the epiphyseal line, while giant-cell tumor and central sarcoma usually do.

One occasionally hears of a diagnosis of an inflammatory bone tumor. My personal experience with three cases in which biopsies were done showed findings of an inflammatory tumor. Two cases have since died and, while no postmortem was done, the patients exhibited all the appearances of malignancy; the third is developing signs of extreme cachexia. The point that arises is, do we in these cases have a presarcomatous change ultimately becoming malignant, paralleling the claim that a chronic gastric ulcer may be pre-cancerous?

Dr. W. Edward Chamberlain (San Francisco): I agree with Dr. Wasson that the differential diagnosis of these bone conditions is very difficult. In the first slide he showed, I mentally noted that the condition was malignant, but he tells us that it was a giant-cell sarcoma.

I recall a case that illustrates our difficulties. The patient was a young woman. A growth developed in the lower end of the femur. The onset and the X-ray appearance were characteristic of giant-cell sarcoma, and it was so diagnosed. Operation of the conservative type was performed. It was possible to preserve the knee-joint and condyles. The patient did perfectly well with a tibial graft in position to support the internal condyle, but a little later there was recurrence of the growth. The patient was sent to the X-ray laboratory, where a diagnosis of malignancy was made, but the surgeon held to the diagnosis of giant-cell sarcoma. After the second operation the patient died of a malignant sarcoma, with metastases throughout the body. We do not know whether this was a benign growth that degenerated into a malignant affair, or whether it was malignant from the start.

Difficulty in deciding the nature of a bone tumor is not confined to the roentgenologist. The surgeon at the operating table has a great deal of difficulty, and the

pathologist has difficulty, although less than his colleagues. In a certain case we diagnosed osteomyelitis from the X-ray appearance of a femur. At the operating table the surgeon pressed plugs of thick yellowish material from holes in the bone, and made a diagnosis of osteomyelitis, but the patient died of a generalized endothelioma throughout the body.

In the scientific exhibit there is a film labeled, "Paget's disease of an unusual type." Dr. Ruggles and I are wondering whether it is not myeloma. Malignant myeloma and myelogenous sarcoma have failed of recognition in many laboratories. Some years ago Dr. Bryan carried slides of one of three cases, subsequently proven by autopsy, all over the country, without the diagnosis of myelogenous sarcoma being suggested.

Dr. W. W. Wasson, Denver, Colorado (closing): I was stimulated to make an effort to gather some data on sarcoma by the fact that all of my cases have been allowed to drift along to amputation and death, and by the fact that so seldom do we know just what the real diagnosis is until after amputation. Also, I wish to try to stimulate this organization to get better bone detail. I think it is possible; for bone was the first thing we were able to show with the X-ray, and we should still be studying bone. If any of you like to play, I think it would be well for you to try playing with the pinhole some time. It is really lots of fun and you will be surprised at what you can see with it. There is no risk, no apparatus is necessary, just a small pinhole in a lead diaphragm, and you can get better detail and you can get enlargement. It has a practical value in that the surgeon will appreciate your effort and every now and then you will run across such a case as I have shown, one that came into the office just a few days ago, in which the surgeon wished to curette out an area in the femur. He did not wish to amputate, because she had metastatic carcinoma. He wished to know how far up the shaft the growth went, and we found it about four inches higher up than showed on the first films.

The history of these cases is interesting. There is, as a rule, very slight injury and later the swelling and still later the discomfort. They pay very little attention to it and yet when you X-ray them you are surprised to find a tremendous amount of pathology. In one case I showed you, I think it was a giant-cell sarcoma, although I cannot say positively, because the pathologist was unable to get enough tissue to make the diagnosis. There was a slight change in the trabeculæ of the bone. That was one of the earliest cases I have ever seen and yet the surgeon allowed that case to wait for six months, until the end of the femur was destroyed. When we come to the point where we can say there is a destructive lesion, if it is destructive, does it matter to the surgeon whether it is inflammatory or sarcoma, or carcinoma, an infection or tumor? I have asked a good many of my friends in the surgical profession to give me a reason why it should matter, and have received none. They say they do not like to go in, that perhaps it is malignant, and yet when I pin them down and ask what difference it makes, they say they do not know that it makes any difference.

Yet our cases are steadily drifting along into a 100 per cent mortality.

FOREIGN BODY REMOVED FROM BRONCHUS UNDER FLUOROSCOPIC GUIDANCE

By PORTER P. VINSON, M.D., Section on Medicine, and CHARLES G. SUTHERLAND, M.B. (Tor.), Section on Roentgenology, Mayo Clinic, Rochester, Minnesota

CASE A445586. A. J., a man, aged twenty-nine years, had aspirated two shingle nails fourteen years before his examination in the Mayo Clinic, October 24, 1923. Four or five days after the accident, one of the nails was coughed up, and the patient remained perfectly well save for an occasional pulmonary hemorrhage. October 15, 1923, there was a pulmonary hemorrhage of such severity that the patient decided to have the remaining nail removed. There had been no fever, loss of weight, or other evidence of marked pulmonary infection. An X-ray examination of the chest revealed a nail in a descending bronchus of the right lung (Fig. 1). October 29, an attempt was made to remove the foreign body through the bronchoscope. A very dense stricture was encountered in the bronchus in which the nail was embedded, and after dilating the stricture as much as possible, the examination was discontinued. November 5, another bronchoscopic examination was made, under local anesthesia. Under fluoroscopic guidance, forceps were forced through the stricture and the nail was easily removed (Fig. 2). The patient was dismissed from the Clinic November 6. His convalescence has been uneventful.

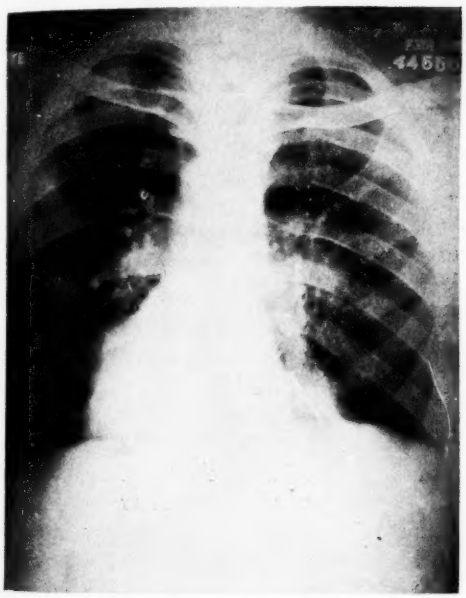

Fig. 1 (Case A445586). Roentgenogram of the chest revealing a nail in a descending bronchus of the right lung.

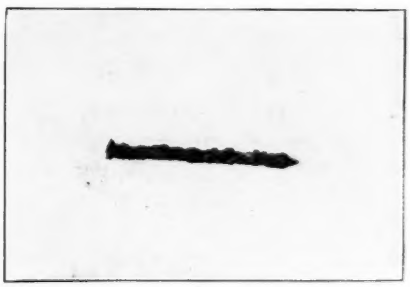

Fig. 2 (same case). Nail removed.

Comment.—The prolonged sojourn of a foreign body in the air passages without pulmonary suppuration is somewhat rare. Without the aid of the fluoroscope, it would have been much more difficult to remove the nail, and probably the risk to the patient would have been greater.

THE USE OF AUDION AMPLIFIERS IN MEASUREMENTS OF BETA AND GAMMA RAY INTENSITIES

By VICTOR F. HESS, PH.D.

CONSULTING PHYSICIST TO THE U. S. RADIUM CORPORATION

BETA and gamma rays are at present used almost exclusively in radium therapy. The ionization produced by these rays is so small that it can be measured only by the use of very sensitive electrometers connected to ionization chambers of suitable size. The handling of electrometers of the quadrant or string type involves certain difficulties and therefore their actual use for experimental work in hospitals is very limited.

Physicists are frequently asked whether it is not possible to use direct reading instruments—for instance, galvanometers of high sensitivity—for these measurements, instead of electrometers. Unfortunately, instruments of this type, as, for example, the Einthoven string galvanometer, are just as difficult to handle and hardly suitable for the purpose in question.

Let us consider, first, the order of magnitude of the ionization effects from beta and gamma rays. The ionization per unit volume of the gas exposed to the rays is smaller for gamma rays than for beta rays. Thus it will be sufficient to approximately calculate actual cases with gamma rays.

It is an all-important problem for the physician to know the relative intensity of radiation from a given radium preparation with known filtration at all distances and in all directions from the source. Some typical cases of this sort can be calculated theoretically,[1] but often a new application of radium or a change in the shape of the preparation brings about a complete change in the intensities at different points around the source of rays. In the majority of cases, the distribution of intensities has to be found by experiments. In these experiments only very small ionization chambers, of one cubic centimeter or less in volume, can be used.[2] For this reason the actual ionization produced in the chambers is so small that electroscopes or electrometers of moderate sensitivity fail to indicate these effects.

In several institutions in this country where physicists are collaborating with physicians, actual measurements with these "micro-ionization chambers" have been performed by means of electrometers of high sensitivity.

The ionization produced by the gamma rays from a known quantity of radium (m) at a known point (r) cm apart is

$$I = \frac{Km}{r^2}$$

where K indicates the so-called "Eve's number"[3]; that is, the number of pairs of ions generated by the gamma rays from one gram of radium at a distance of one centimeter from the source of rays. K varies somewhat with the material from which the walls of the ionization vessel are made, the secondary rays giving a considerable increase in the case of heavier elements. With air-filled brass vessels, K is found to be about 6.10^9 ions/ccm.sec.gRa.

Accordingly, the gamma rays from 10 mg. of radium produce in air at a distance of 10 cm., 600,000 pairs of ions, each carrying the elementary unit charge ($4.77.10^{-10}$ electrostatic units). If the voltage applied at the ionization vessel suffices to give saturation current, all these ions are deposited on the central electrode. The current, that is the incoming charge per second, therefore, is:

$600{,}000 \times 4.77 \times 10^{-10}$ = about 3.10^{-4} electrostatic units = 10^{-13} amperes.

[1] V. F. Hess, *Physical Review*, N. S., vol. 19, p. 73-79.

[2] W. Friedrich, *Strahlentherapie*, Leipzig (1919); Henry Schmitz, *American Journal of Roentgenology*, 1921.

[3] A. S. Eve, *Phil. Mag.* (6), vol. 12, p. 189, vol. 22, p. 551, vol. 27, p. 39 (1914).

This is the lower limit of the order of magnitude for ionization vessels of one cubic centimeter. At smaller distances, currents will be much larger, going up to 10^{-12} and 10^{-11} amperes.

Galvanometers which can be used without difficulty by those who are not physicists ordinarily do not indicate currents of less than 10^{-8} amperes. The currents considered above are from 1,000 to 100,000 times smaller.

The whole problem in question, therefore, is to find an experimental arrangement which makes it possible to amplify a given direct current—in this instance the ionization current produced in a small air chamber—in a ratio of 1:100,000.

Amplifications of this order of magnitude have been accomplished in the past few years for different purposes by the use of audion bulbs or similar thermionic valves.

These "Triode Bulbs" consist of a small glass tube evacuated to a very high degree and containing three electrodes: the anode (a plate or cylinder), the grid (coil or wire gauze), and the cathode (tungsten filament), in V-shape, made incandescent by an auxiliary current. Tubes of this sort were originally designed for the purpose of amplifying weak alternating currents (electric oscillations) in radio-telegraphy or telephony.

Triode bulbs can be used for the magnification of direct currents—for instance, ionization currents—just as well.

At any rate, the electrode which receives the incoming charge in the ionization vessel has to be connected to the grid of the audion bulb. Every change in the potential of the grid causes a change of the magnitude of the plate-filament circuit. If two audions of the same type are used and connected to the same battery and their filaments heated by the same auxiliary current, it is very easy to compensate the plate-filament currents in both bulbs. This arrangement was suggested first by J. C. M. Brentano[4]. A galvanometer is inserted in a bridge connecting the anodes of the two audion circuits. A similar arrangement was used by H. Greinacher and H. Hirschi[5] for the measurements of ionization produced by alpha rays from radium or thorium emanation, and successive substances, in determinations of the radium and thorium content of rocks.

The experimental arrangement for our present purpose is but slightly different. It is shown in the diagram (Fig. 1). The anode of the battery E (constant voltage of 60–100 volts) is connected to both ionization vessels V and V′. These are of hemispherical shape, having a volume of one cubic centimeter or even less. The inner electrodes, ending in a little ball, are protected by a guard ring (not shown in the figure), and connected to the grids Gr and Gr′, which are insulated.

The anode of E is also connected with the plates A and A′ of the two audion bulbs over two resistances, r and r′, which are about 10,000 ohms each, and equal; r and r′ serve for the protection of the battery and the galvanometer, the latter being inserted in a bridge between the ends of the two resistances. It is good to use a galvanometer of small resistance, that is, small compared with r or r′.

The filaments F and F′ are heated by the same battery (e), which can be regulated by small resistances, r_1, r_2, r_3 (sliding rheostats). This arrangement was chosen to avoid disturbances caused by variations in the emission of electrons by the hot filaments. Whenever such changes occur they will occur simultaneously in both bulbs, thus not affecting the compensation.

The inner electrodes of the vessels V and V′ are connected to Gr and Gr′ by flexible cables coated with thick soft rubber, the outer surface of which is made conductive and connected to earth. The leads BV and B′V′ are ordinary, well-insulated, flexible cables. All leads and the bulbs are surrounded by earthed metallic cages and

[4]Brentano, *Nature*, 1921, vol. 108, p. 532.

[5]Greinacher and Hirschi, *Schweizer. Mineral u. Petrograph. Mitteil.*, 1923, vol. 3, p. 153-59.

tubes, in order to avoid electrostatic disturbances from outside.

It is not necessary to heat the filaments to as great a degree as in radio work. Therefore, it is much easier to keep the arrangement in good working order and the durability of the bulbs is considerably prolonged.

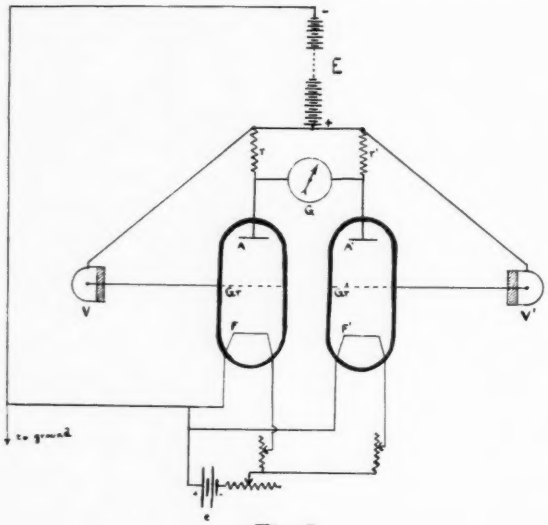

Fig. 1

The procedure of the actual measurements is as follows:

One of the ionization vessels, for instance V′, is surrounded by a lead block of sufficient thickness to absorb direct and scattered radiation from the radium preparation. On account of the small volume of the chamber, not much lead is required to give proper screening. Ten centimeters of lead all around absorb more than 99 per cent of the most penetrating, gamma, rays. The other ionization vessel is mounted on an adjustable stand and exposed to the gamma rays at the desired point. Screens or layers of absorbing material, for instance, human tissue, can be inserted between the source of radiation and the vessel.

Before the radium is brought into the room, the heating battery (e) is turned on and the resistances adjusted until the galvanometer is at zero. It is recommended that shunts parallel to the galvanometer be used and to gradually increase the accuracy of compensation, decreasing the ratios of the shunts, in steps from 100:10:1. The stationary state of heating is reached in about thirty minutes from the time when the current is turned on. Then everything is ready for the experiment.

The radium is brought in and placed at the desired distance from vessel V. The ionization current inside of this chamber flowing to the central electrode renders the grid (Gr) more positive than Gr′, since the current in Gr′ is negligible ("normal leak"). This change in the grid potential immediately causes a current to flow through the bridge and the galvanometer.

H. Greinacher and H. Hirschi have shown that this bridge current is proportional to the ionization current in V. This relation holds, even if the current in the audion bulbs does not exactly obey Ohm's law, in the case where the electronic currents are not far from their saturation values.

With amplifiers as they are used for receiving sets in radio-telegraphy and radiotelephony, it is not difficult to make the ratio of the bridge current to the actual ionization current (in V) as high as one million. For the present purpose, it will

suffice to use ratios of 10,000 or 100,000. The easiest way to change quickly this ratio is a shunting of the galvanometer. But here, as Greinacher and Hirschi have already stated, it must be remembered that the bridge current is proportional to the change dI of the anode current (circuit anode-filament in bulb 1) only if the actual current through the galvanometer is small as compared with dI. With instruments of 10^{-8} amperes' sensitivity, this condition is always fulfilled.

Thus the galvanometer deflections give the relative intensity of ionization at any distance from the preparation, wherever V is placed.

Our arrangement can be used advantageously for other and more complicated measurements: for instance, when the amount of secondary radiation in a certain depth within human tissue has to be determined. Here both ionization vessels V and V′ are used simultaneously.

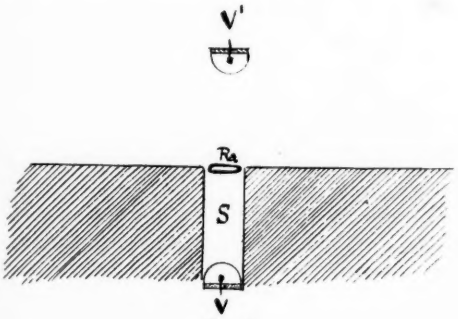

Fig. 2

They are placed symmetrically to the radium at the same distance, one in free air, the other at a place in the desired depth within the tissue. The tissue in the direct cone of rays can be cut out if absorption is to be avoided. It is not necessary to work with real tissue. Dummies consisting of paraffin or ice blocks give approximately the same secondary radiation.

Absorption can be measured by filling the space S. The advantage of our double ionization chamber is obvious: no correction for normal leak is necessary, since the bridge current is proportional to the difference of the currents flowing in V and V′.

Our arrangement can be used also for comparison of different radium preparations. One chamber is exposed to the gamma rays, the other well screened, and the distance of the radium preparation adjusted until suitable galvanometer deflections are reached.

Where beta radiations are to be measured, the ionization vessels have to be fitted with openings on top of the hemisphere which are covered with a thin mica plate, or the wall of the chamber must be made thin enough to allow the passage of beta rays.

Roentgen ray intensities can be measured just as well with this method, but in this case galvanometers of much lower sensitivity are used.

SUMMARY

The weak ionization currents caused by beta or gamma rays in very small ionization vessels as they are used for comparative measurements in radium therapy, can be determined by amplification with three electrode vacuum bulbs and the use of an ordinary galvanometer. The method, consisting of an arrangement similar to a Wheatstone bridge and requiring two equal ionization chambers of small volume, can be applied to measurements of the relative intensity of gamma rays at different distances from the source of rays, to determinations of the secondary radiation, of the absorption and for the comparison of radium preparations.

FILM DEVELOPING IN A LIGHTED ROOM

By I. S. TROSTLER, M.D., CHICAGO

ABOUT fourteen years ago I was called to one of the Chicago suburbs to make a roentgen examination of an old lady's hip, and was informed that I could use the local photographer's dark room to develop my plates.

After making the exposures with my portable apparatus I went to the "gallery," only to find that the photographer had just broken the only ruby glass he had for the front of his dark-room lamp. He had plenty of dark, but no light. He also had some pretty well oxidized Pyro developer which I decided to try out. Shading the light with only an amber colored glass, and covering that with the focusing cloth so as to exclude all the light, I began development of one of the plates in complete darkness. After some two or three minutes I cautiously lifted one corner of the focusing cloth and examined the plate, keeping it in the brown colored developer all the time. Watching the plate in this way, by occasional examinations with the yellow light I managed to complete the development of one of the plates, and from it made a diagnosis.

After returning to my own dark room I experimented further with the process, as it interested me. I was using Cramer's old slow plates at that time, and found that if I immersed the plates in any dark colored or oxidized developing solution in complete darkness for about a minute I could finish the process in light sufficient to watch the development. I discussed the matter with two other roentgenologists (both of whom have since passed to their reward on high as the result of cancer), and let the matter drop as a closed and useless incident.

During the last two or three years photographic literature has contained several discussions of desensitizers. Being reminded of my interesting experience in the dark room in Wheaton, I began figuring upon the matter again, and have come to believe that the process has a place in our work.

It must, of course, be understood that the development in a dark colored solution is not the same as true desensitization. The latter is a true chemical reduction of sensitiveness of the emulsion to light, while the former is in effect the coloring of the light which reaches the emulsion. There has been much discussion regarding the theories and methods of the action of these agents. Up to this time it has not been definitely decided exactly how and why they produce their effect. That the effect is produced concerns us more than do the reasons and theories.

Certain well known reducing agents, photographically known as developers, have the property of reducing sensitiveness to light on photographic emulsions. A well known example of this is Amidol, which will reduce the sensitiveness to light to about $\frac{1}{200}$, if used in approximately $\frac{1}{20}$ to $\frac{1}{16}$ of 1 per cent (one part in 1,600 to one part in 2,000).

Lately the attention of the photographic world has been called to the action of safranine, tolu-safranine, and pheno-safranine as desensitizers. Any of these agents added to the developing solutions in the proportion of 1 to 2,000 permits of development in a fairly good light without danger of fog. The best way to use these agents is to have them in solution and to add this solution in definite quantity to the developing solution. Pheno-safranine is probably the most satisfactory. It, like the other safranines, is a red dye, but has been proven to act more by chemically changing the sensitiveness of the silver emulsion than because of its color. A good working formula for Eastman duplitized films is as follows:

Safranine, or pheno-safranine 1.0 grams
Water .....200. c.c.

For use add 20 c.c. of this solution to 1,000 c.c. of any good Metol-Hydrochinon developer.

Immerse film in total darkness or regular dark-room light for one-half to one minute, after which a rather bright yellow light may be turned on with complete safety. Wash and fix as usual. Thorough washing will usually remove all the dye. If the resulting washed negative is stained more than is desired, the stain can be removed (after fixing and washing) by immersing about four minutes in the following stain remover:

Sodium nitrite (not nitrate) .....60 grains (4. grams)
Hydrochloric acid (pure) ..... 2 drachms (8. c.c.)
Water .....24 ounces (700. c.c.)
Remove and wash for not less than five minutes.

Numerous other chemicals have similar desensitizing properties to a greater or less extent, notably 1 per cent picric acid added to the developer. Potassium chromate and chrysoiodine may also be mentioned as useful in this way, but pheno-safranine and safranine are the best, easiest to handle, and do not cause a deterioration of the Metol-Hydrochinon developing solution. Solutions with safranine or pheno-safranine keep as well as or better than without it, and the desensitizing action remains the same for a long time. Pinakyptol, an aniline product of one of the German dye works, is a patent desensitizer for which great claims are made, but I prefer the safranines.

Incidentally, it may be mentioned that much less Metol may be used if the safranines are added to the developing solution.

While there is no great crying need for the above process and the routine use of the methods outlined, those who have a marked dislike for the dark room will find it a desirable relief.

I believe that all radiologists (even we old-timers) should occasionally develop a film. It keeps us in closer touch, and we know if those in charge of our technical work are up to that high standard that modern medicine and methods demand.

To those who have an interest in photography and like to do their own developing, I can assure much pleasure and interest in this method. To those who make their own lantern slides this method should prove a boon, as you may watch the development and secure the degree of density that you want with greater accuracy than by any other means.

EDITORIAL

DANGERS IN DEEP THERAPY

The gradual refusal of the various insurance companies to write insurance for physicians against malpractice suits, and especially for those who specialize in radiology, shows that the laity are regarding the practice of radiology as a dangerous procedure. It more likely indicates, since anyone, even a layman or a quack, may purchase radium or the most powerful X-ray machine and use it, that the radiologist is being regarded individually as a dangerous practitioner.

One of the largest insurance companies has increased its premiums during the past year 888 per cent. We, as regular medical radiologists, know that such an increase is unjustifiable, but it is likely that there have been so many threats of suits during the past year and for such large sums, that the loss of a single suit would involve an insurance company seriously.

There are several causes for this state of affairs.

1. The entire social state has been disturbed by the great war, and this condition has been reflected to the relations between patients and even the physician. Time and patience will overcome this condition.

2. The risks have been increased by the unjust rulings in certain states that the presence of an "X-ray burn," so called, is *prima facie* evidence of negligence. This can be overcome by educating the courts to the fact that there is undoubtedly an idiosyncrasy or a very variable sensitivity of the tissues among individuals. This is demonstrated in any group of animals, used for experimental purposes, in which one can find as much as 100 per cent variation, even among animals of the same breed, the same age and even the same litter. Is it surprising, then, to find a corresponding difference among individuals of the human race, who are of very different breeds, different ages and, of course, families? Should a physician, then, be punished for some unforeseen condition over which he has no control?

3. The readiness to blame the radiologist is further enhanced by the fact that the radiations work in an invisible, insensible and mysterious manner. Therefore, any condition that develops after radiation is generally ascribed to the action of the rays, when, as a matter of fact, it is usually only coincidental. Even physicians often take this attitude instead of searching for the real cause of the symptoms. Much will be accomplished if we eliminate the incorrect words "X-ray burn" or "radium burn" from our vocabulary. Many conditions may resemble a radiodermatitis, or degeneration, following radiation, therefore one should be cautious in making a diagnosis.

4. The most serious cause of this precarious position of the radiologist is a real one. Many physicians and others belonging to various cults have undertaken to do X-ray work with little or no training, and little or no study. A glib salesman speaks of the remarkable work done by some radiologist who has devoted his life and his entire time to this subject (without reminding the prospective purchaser of this fact), and leads the purchaser to believe that the merits are all in the machine. The machine is purchased by an individual or by a hospital; a day's instruction is given by someone connected with the sales organization, or, if the sales organization is complete, a week's instruction may be given to a class by a physicist. Then X-rays are produced. No consideration is given. in such instances,

to the clinical application of these rays, and harmful results follow, as would be expected. The more powerful the X-ray machine, the more serious is the damage.

This is not meant to be a criticism of the instruction in physics, which has been given in this country or Europe. It is very valuable and almost an essential, but it must not be looked upon as sufficient. Deep roentgenotherapy is a most difficult subject, involving as it does studies in pathology, clinical diagnosis, and symptomatology, as well as the mastery of radiotherapeutic technic, which technic varies with the diseased condition.

We can overcome this latter state of affairs only by urging the most thorough and painstaking preparation for the work, and eliminating the idea that the purchase of a powerful X-ray machine implies preparation, or that a physician who is appointed to take charge of the X-ray department of a hospital automatically becomes an "X-ray expert."

Let us be cautious, teach caution, and take no unnecessary risks. When serious risks are essential, let us explain these risks in advance to the attending physician or the family. This implies knowledge of the risks involved, and of the conditions present, neither of which can be had by any but the thorough student.

Let us use all practical safety devices. Above all, avoid the omission of a filter. This can be done by having two persons investigate every "set-up." The target skin distance should also be checked by two persons. Then, if the various measuring instruments, including the time, are carefully watched, little harm will result, and no lawsuits will ever be successfully waged against the radiologist.

G. E. Pfahler, M.D.

AWARD OF GOLD MEDALS

An occasion of solemnity at the meeting recently held at Rochester, Minnesota, was the award of a gold medal to Dr. Emil G. Beck and one to Mr. Clyde Snook, for achievements in Radiology.

It is the custom of this Society to recognize meritorious accomplishments.

Both recipients have measurably elevated this specialty: Dr. Beck by his constant allegiance to and participation in radiological activities and eminence gained in the development of stereoscopy; Mr. Snook by perfecting the transformer, notably the commutating switch, which revolutionized radiological technic.

Dr. Russell D. Carman presented the honorarium to Dr. Beck personally; Mr. Snook, because of serious illness in his family, was not able to attend.

The Society accords to both these men the recognition so well deserved and extends to them its whole-hearted co-operation.

Response of Dr. Emil G. Beck

Mr. Chairman, Ladies and Gentlemen: I deem it a great honor to receive this medal from the Radiological Society of North America. It would mean even more to me if I were certain that I had deserved it, because I have not devoted my energies entirely to the science of radiology. Sometimes I wonder why I have not, for I was fascinated with this science when it was in its infancy and before I had definitely chosen a specialty. It has been a privilege to work with you. My close association and co-operation with radiology and its workers have been a great help to me in my surgical work.

I have never been able to understand why radiologists should not be more closely associated with medical men and surgeons, as co-operation is bound to be of much benefit to both and productive of greater efficiency and of the greatest service to the sick. It shall always be my aim to foster a closer relationship among roentgenologists and surgeons.

Radiologists have been accused of being too enthusiastic. This comment is not a reflection; it is rather a commendation. Without enthusiasm there would be very little progres. We must, however, not confuse the term "enthusiasm" with the terms

"exaggeration" or "boastfulness." Exaggeration is a sign of weakness in an argument or a position and boastfulness is always repulsive to real scientists. Radiology has enough merit to claim recognition and needs no exaggeration to establish its position in the branches of sciences.

When we look back to what we have accomplished in the last twenty years in the diagnostic as well as the therapeutic field, we may safely say that medicine has no greater ally than the radiologist.

RESPONSE OF MR. SNOOK

Mr. President, Members of the Radiological Society of North America, Ladies and Gentlemen: Thank you for the great honor that you confer upon me. It is a thing I shall always appreciate, and cherish.

I am glad to have had the privilege of contributing some part to the world's progress. I am glad if what I have done may help make the world a bit better, if it may be of service to humanity.

The friendliness and kindness that prompt you to give me this medal are of value not only to me but to all engineers and scientists. Your generosity will be appreciated not only by me but also by many other engineers and investigators.

The rewards of the engineer and the technical man do not appear attractive to the average man of to-day.

During the past twenty-five years the enrollment of our colleges and universities in the United States has quadrupled; but in the same period the increase in number of those taking engineering and scientific training has approximated only twenty per cent.

Our material progress is based upon the work of our scientific men; but our industries to-day face a shortage of technically trained men.

Despite the startling and vivid pictures the recent World War gave us of our material dependence upon the engineer and the scientist, the average young man of to-day elects to prepare for a different career. He selects a life work the way to which appears less hard and the goal of which offers promise of greater rewards.

The mechanical and electrical engineering courses of our colleges are not popular to-day. The young men who obtain good training in fundamental science are very small in number.

And the men who not only get a general training in fundamentals but also fit themselves by graduate work to push back the limits to scientific knowledge are very few indeed.

Unless the present tendencies of young men to avoid the preparation for this kind of work are changed and unless its rewards appear more attractive to them we will be confronted by a pause in the material progress of our country. We need more engineers to-day, and we will need still more tomorrow.

And so, Mr. President, if the generosity of the Radiological Society of North America in giving to me this great honor can be of encouragement to the engineers and scientific men of our land, it will have served a greater purpose than merely the distinguished honor I enjoy.

If the bestowal of this medal can in a small measure help to draw the attention of the youth of America to our scientific and engineering needs, and if it can help to increase the number of scientific workers, it will give me for this reason a satisfaction greater than the possession of the medal.

Again I thank you, generous friends, for I think you have done well, not so much for me, but for interest in this new science of ours and for the encouragement of the youth of America.

The Cleveland Radiological Society was organized Nov. 12, 1923, at the University Club. The following members are officers: Dr. Geo. F. Thomas, President; Dr. E. F. Freedman, Vice President; Dr. John D. Osmond, Secretary and Treasurer. The meetings are to be dinner meetings and are to be held on the second Monday evening of each month. The second meeting was held at the Union Club and interesting films and lantern slides were presented and discussed.

BOOK REVIEWS

DIE LUNGENPHTHISE. ERGEBRIESSE VERGLEICHENDER ROENTGENOLOGISH—ANATOMISCHER UNTERSUCHUNGEN. By SIEGFRIED GRAEFF, Professor of Pathologic Anatomy at Heidelberg, and LEOPOLD KUEPFERLE, Professor of Internal Medicine at Freiburg. Published by Julius Springer, Berlin, 1923.

This instructive work comes in two paper-bound volumes, a text section of 234 pages and a picture section with 221 illustrations. Typographically, both sections are admirable; paper and print are of the highest quality, and the illustrations are of surpassing excellence.

The first fifteen pages are given to the methods and principles of correlating the roentgenologic and anatomic findings. Thirty-five pages are devoted to the pathologic anatomy and classification of pulmonary phthisis. Fifty-two case reports constitute the bulk of the text. These are set forth in elaborate detail, comprising the clinical history, roentgenologic manifestations and necropsy report. Each case is illustrated in the picture volume with roentgenograms made during life and photographs of the sectioned lungs after death. The interval between roentgenography and necropsy was often considerable, and the comparison may thus be vitiated to some extent, as the authors admit. However, this apparently does not seriously affect the value of the method, and the correspondence of the lesions shown in the photograph with their shadows in the roentgenogram is rather exact, as a rule. This objectively demonstrates the effects of the various types of lesions on the character of their shadows.

The book closes with a general chapter on the radiologic diagnosis of the disease. Notwithstanding this feature, the reader will be disappointed if he expects to find a voluminous discussion of technic, interpretation and differentiation. The work does not assume to be a complete exposition of the radiologic phases of tuberculosis, but, as its title indicates, is essentially a comparative roentgenologic and anatomic study. As such, it contributes substantially to the knowledge of roentgenologic diagnosis, and well deserves a place on the roentgenologist's book-shelf.

ALBERT MILLER, M.D.

PRINCIPLES AND PRACTICE OF X-RAY TECHNIC FOR DIAGNOSIS. By JOHN A. METZGER, M.D., Roentgenologist to the School for Graduates of Medicine, Medical Department, University of California, Southern Division, Los Angeles. Cloth, 144 pages, 61 illustrations, price $2.75. Published by the C. V. Mosby Company, St. Louis.

The binding, paper, quality of illustrations, and general makeup are good. The glossary of medical terms is fair, but not entirely in agreement with accepted terminology.

The author's preference for fluoroscopy in dislocations does not agree with the accepted practice, is not considered to be a safe method to rely upon, and is a dangerous practice for the roentgenologist to indulge in.

In Figure 5A the same direction of principal rays is given for mastoids and for inferior maxilla. This error is properly corrected in Figures 11 and 12. On page 44 the author directs that the patient be placed "face down on the table" for radiographic examination of the mastoid, but illustrates the correct position of it in Figure 11. In Figure 6 the Waters position, so much used in nasal accessory sinus examination, is titled "anteroposterior head position."

It seems to the reviewer that it would be rather difficult to bend a plate so as to use it as illustrated in Figure 16 (anteroposterior position for cervical spine).

In Figure 23 "anteroposterior position for pelvis *in toto*," the apparatus is set so that only the sacral position would be shown on the plate, although the description of the technic is correct. In the technic given for examination of the hip no mention is made of rotation of leg and thigh so as to pre-

sent the longest axis of femoral neck parallel with the plate.

In Figure 26, "clavicle position," the patient is shown resting upon her chin. If her head were rotated so she could rest on one side of her face she would be much more comfortable and the result would be just as good or better.

Anteroposterior and lateral positions of the wrist are mentioned. Why not use anatomically correct terminology, as radioulnar, and dorso-palmar?

The reviewer cannot help wondering why a cathartic is administered the evening before an examination of the esophagus.

The gastric and duodenal examinations are described according to the author's technic, and are those generally followed by many radiologists, but acacia mucilage at 100 degrees (presumably Fahrenheit, though not stated) would tend to nauseate many patients. Technic given for colon is the method in use by most modern workers, as is also that recommended for the urinary tract.

Chapter IX, "Stereoscopy (stereoroentgenography) and Localization," is the best of any in the book. Chapter X, "Dental and Oral Radiography," is good. The chapter on developing room appliances and technic is good.

Taken as a whole, the book is as good as most of the works upon this subject, and except where mentioned, is as good a handbook as anything we know of.

I. S. TROSTLER, M.D.

ABSTRACTS OF CURRENT LITERATURE

SICARD, J.-A., AND FORESTIER, J.: THE USE OF IODIZED OIL FOR RADIOLOGIC CONTRAST (EXPLORATION RADIOLOGIQUE PAR L'HUILE IODEE). *Presse méd.*, 1923, XLIV, 493.

The remarkable opaque qualities of concentrated iodized oil to X-rays, although known, do not appear to have been utilized for clinical investigation. According to the authors the iodized oil is easily tolerated by the tissues, is painless, and its use is not followed by troublesome sequelæ of any kind. But it has further qualities, inasmuch as it acts therapeutically in certain conditions.

The authors in this article deal only with the use of iodized oil in radiologic exploration. The vehicle used is an organic combination of iodine with poppy oil. It is rich in iodine, containing 0.54 grams of this substance per cubic centimeter. This substance is named lipiodol.

The authors illustrate several conditions in which lipiodol is applicable for radiologic investigation. It may be injected subcutaneously, intramuscularly, in the lumbar cavity, or in the spinal vertebræ. The authors say that, for instance, injection of lipiodol is remarkably easy in atlas-occipital punctures. In several cases they have been able to inject one cmc. of lipiodol into the atlas-occipital cerebrospinal fluid and in this way explore the whole of the subarachnoid spinal cavity. They think that this will be the method of choice in the future for high explorations; further, they give a number of examples showing the technic and findings in spinal conditions, including spinal compression, meningitis, Pott's disease, etc.

In the investigation of fistulæ iodized oil can advantageously replace bismuth paste. It is also of great value in investigating the arborizations in broncho-pulmonary cavities after intratracheal injection. This is the first time that it has been possible to obtain such radiographic plates in the living subject.

Iodized oil, owing to its great opacity to the X-rays, to its penetrative qualities, to the different aspects which it assumes according to the region injected, to the persistence of the radiographic images to which it gives rise, to its harmlessness and absolute tolerance, deserves a position of the first rank among substances suitable for clinical radiologic explanation. By its use it has become possible to examine under the screen cavities in the organism, especially the subarachnoid, epidural and broncho-pulmonary spaces, which were previously inaccessible to investigation by procedures of this nature.

MINOUFLET, C., AND SCHRUMPF-PIERRON, P.: REACTION OF THE BLOOD AND TISSUES UNDER THE ACTION OF THE X-RAYS (REACTION DU SANG ET DES TISSUS SAINS OU PATHOLOGIQUES SOUS L'INFLUENCE DES RAYONS X). *Arch. d'élect. méd.*, Bordeaux, 1923, XXXI, 161.

From a number of clinical and experimental studies which they give, the authors find that generally the effect of light and medium X-ray-

ing is an increase in the red corpuscles and a leukocytosis. When the irradiation is intensive and prolonged, and especially when the irradiated tissues are rich in vessels, a certain number of red corpuscles may be destroyed, but the anemia is rapidly repaired by the activating effect which the rays exert upon the erythropoietic centers.

In the course of a prolonged irradiation there is sometimes a direct destructive action in regard to a small number of lymphocytes; however, on the other hand, it is impossible to affirm that there is any harmful effect on the leukocytes, the production of which is actually increased by the action of the rays.

Irradiation, just the same as with operation, re-establishes and intensifies the chemotaxic power of the connective tissues. A leukopenia can thus be produced which is sometimes preceded by a leukocytosis.

If the activation of the chemotaxic power of the defensory tissues is insufficient, while the hyperfunctioning of the leukopoiec tissues is maintained, we find a progressive leukocytosis consecutive to a temporary leukopenia. If, on the other hand, the leukopoiec tissues are insufficient, there is a progressive leukopenia.

In regard to the physical action of X-rays upon living beings, the specific action of the rays on the organism consists in a modification of the reciprocal potential energies of the different parts which constitute the organism; as a result of this there is a modification of the osmotic exchanges and of the intracellular chemical reactions, as well as more or less severe and more or less persistent disturbances of nutrition.

The authors in discussing the technic of irradiation say that as far as possible it should be the rule to apply the dosage required at a single séance. They state that since the first irradiation completely modifies the equilibrium of the tissular potentials, a later irradiation approximated to the first finds the tissues in conditions totally different from what they were before the first application; and that the biologic action of the rays is also entirely different, so that effectively the estimation of the effect of a known dosage becomes impossible. This really explains the phenomena of sensitization to the rays.

The authors think that modern radiotherapy ought not to be considered as the specialty of a radiologist, but that surgeons, gynecologists, dermatologists and physicians should consider it as part of their armamentarium, employing this mode of treatment when they think it would be effective. All that is necessary is that the clinician should know in how many minutes his apparatus furnishes an erythema dose and what percentage of this penetrates to depth.

In concluding their article the authors consider the blood reactions after an irradiation as elements of prognosis in cases of neoplasm.

The prognosis of a neoplasm seems to be always better when the patient shows normal numbers of white and red corpuscles before irradiation. A globular anemia as well as a leukocytosis suggests a bad prognosis.

When the blood reaction after irradiation is typical it may be assumed that the treatment will have a good result. The fact that a tumor diminishes rapidly in volume after irradiation is less important from the prognostic viewpoint than the typical blood reaction and amelioration of the general state.

When the blood reaction after irradiation is "atypical" it may or may not be due to some error of dosage or technic. When no such error has been found a second application has but little chance of success; but if there has been an error, a second dose should be applied after a suitable interval.

Although in general in favorable cases it is topographically possible to apply over all the tumor at one séance the full dosage necessary, yet sometimes it is only after several months that the favorable effect will be seen.

SANTE, L. R.: CLINICAL HISTORY AND SERIAL PLATE EXAMINATIONS, IN THE DIFFERENTIAL X-RAY DIAGNOSIS OF INFLAMMATORY LESIONS OF THE CHEST. *Jour. Mo. St. Med. Assn.*, 1923, XX, 194.

In recent years instantaneous radiography and bedside examinations have made acute inflammatory conditions of the chest amenable to this method of examination. Serial radiographic examinations, or radiographs taken at intervals of a few days or weeks, are valuable in following the course of acute inflammatory diseases of the chest and directing treatment, and have been in use at the St. Louis City Hospital for the past three years, with great satisfaction.

The lung fields can be divided into three zones: (*a*) the inner, containing the hilus shadow; (*b*) the middle, containing the peribronchial markings of the larger branchings; (*c*) the outer, containing only the finer terminal markings of the smallest bronchioles. Any encroachment of the hilus markings upon the middle space should be considered as pathological. An increase in the hilus shadow may be caused by the pathological involvement of any or all of the structures of which it is composed. Enlargement of the hilus nodes is pathological whether it be from regional lymphatic involvement, from an inflammatory process, from a tuberculous adenitis, lues, Hodgkin's disease, or

malignancy. But enlargement of the hilus shadow from any of these causes may under certain circumstances be so similar in appearance as to render an accurate diagnosis impossible. Diagnosis, which is practically impossible without the aid of the clinical history and symptoms, often becomes quite easily established when the roentgen findings are viewed in the light of this clinical evidence. Serial radiographic examinations, where no more than two or three plates taken at intervals are available, are often sufficient to indicate the cause of the disease.

Again, lesions causing engorgement of the lymphatics, such as infection; any condition causing engorgement of the blood vessels, such as passive congestion; or any chronic inflammatory process, such as chronic bronchitis, result in an increase of the peribronchial markings. The clinical history is often of great aid in differentiating these conditions, especially in congestive and cardiac disease. Serial radiographic pictures are most helpful in differentiating the tuberculous from the inflammatory lesion, subsequent radiographic examination revealing the retrogression of the inflammatory process and the persistence of the tuberculous lesion.

It must not be inferred that no conditions are sufficiently characteristic to render a correct diagnosis possible without consideration of the clinical history; but it is hazardous in any instance to express a positive opinion without a previous consideration of the clinical symptoms. Even this at times is insufficient to determine the diagnosis, and serial radiographic examinations must be resorted to, the ultimate diagnosis being deferred until the course of the disease, depicted in subsequent radiographs, gives the clue to the causative condition.

SIMONETTI, A.: STIMULATION OF THE STOMACH BY THE X-RAYS (CONTRIBUTO ALLO STUDIO DELLA STIMOLAZIONE DELLO STOMACO COI RAGGI ROENTGEN). *Gazz. d. osped. e. d. clin.*, Milan, 1923, XLIV, 36.

Up to now the diagnostic and destructive effects of the X-rays have been studied, but only limited efforts have been directed toward studying the therapeutic stimulative action of the X-rays upon the internal organs. Such an investigation has been made by Simonetti in regard to the stomach. The study was made on eleven patients; four were affected by the sequelæ of lethargic encephalitis; two had exudative pleurisy; three had pleuritis; one, gastric carcinoma and one, enterocolitis. Besides, one had also gastric catarrh and one, chronic gastritis.

An Ewald test meal was administered and the irradiation of the stomach commenced from five to fifteen minutes later. A No. 7 hard roentgen tube was used; focal distance 23 cms.; intensity, 2 m.a.; filter, aluminum, 1 mm., lead, ¾ mm. The irradiation lasted from three to seven minutes.

The results obtained are given in a table. Analysis of these results shows that—

In the eleven patients in whom thirteen applications of the rays were made, the total acidity of the gastric juice was increased after ten of the applications; it was diminished after three applications.

Free hydrochloric acid had been observed in seven of these individuals; it was absent in the others. On the seven patients there were eight applications of the X-rays. The free acid was increased seven times after stimulation by the rays; four times on the same day of stimulation and three times on the days following. The free acid was decreased in one application.

Pepsin content was increased after eight out of twelve applications; it was diminished in three; and it remained constant in one.

From his investigations Simonetti thinks that it may be concluded that stimulation of the stomach by the X-rays is in the majority of cases accompanied by changes in the value of free hydrochloric acid, in the total acidity, and in the pepsin content, and more especially by an augmentation in the contents of these substances in the gastric juice. The augmentation sometimes occurs on the same day as the stimulation; sometimes one or more days later.

The X-rays ought to be studied therapeutically not alone on account of their destructive properties, but also on account of their eminently stimulative qualities when applied in suitable dosage.

LECONTE, M.: MODIFICATION OF AORTIC OPACITY ON RADIOSCOPIC EXAMINATION (LES MODIFICATIONS DE L'OPACITE AORTIQUE A L'EXAMEN RADIOSCOPIQUE). *Presse méd.*, 1923, XLI, 463.

Leconte treats of the diagnosis of certain types of aortitis by studying the modifications of aortic opacity.

In the normal state in the young the aortic shadow is gray, but its contour is clearly visible and the degree of opacity is always less than that of the shadow of the left ventricle. In older subjects the shadow is darker and approximates that of the cardiac shadow. In the pathologic state the aortic shadow may be as dark or darker than that of the heart. Sometimes the opacity affects the image of the whole vessel, sometimes the shadow is spotty and unequally distributed. The maximum opacity depends especially upon the state of the walls, their thickness, and the presence of calcareous plaques. There is thus a

regular gamut of densities which may be employed in distinguishing different pathologic conditions.

The qualitative examination of the aorta also gives interesting findings as regards the situation of the aortic arch, on the contours of the vessel, on the presence of peri-aortitis, and finally on the pulsations, the amplitude of which is often changed. All these are essential findings in the study of the pathologic aorta.

Leconte discusses four groups of cases. In the first group the functional and physical symptoms are clear and the radiologic findings complete; in the second group the functional symptoms are clear, the physical symptoms obscure and the radiologic findings complete; the third group is the same as the second but the radiologic findings are incomplete. In the first group the radioscopic examination is not redundant to the clinical because it furnishes precise information in regard to the vascular state.

But it is especially in the third group of cases that radiologic investigation is important. In these cases the radiologist finds only modification in the aortic opacity. Of 206 patients with aortitis, examined by Leconte, 57 showed an opacity modification alone. The diameter of the aorta may be normal or nearly so and was such in 39 of the 57; also the volume of the heart is generally normal.

The alterations in the opacity translate infiltration or sclerosis of the aortic tunics and this may be observed at all ages. In the 57 cases seen by the author the age of the patient varied from 20 to 69 years; but it is relatively more frequent in patients who are young. Forty-one of the cases were in patients aged from 20 to 50 years. Thus the hypothesis seems to be confirmed that qualitative modifications of the aortic shadow represent the initial evolvutive phase of lesions of the vessel.

There is a fourth group of aortitis cases in which the functional symptoms are typical, and the physical symptoms obscure, but in which radiology shows modifications in the aortic opacity. Such cases may have an etiology connected with systemic disturbances, and it is only by chance that a radiologic examination shows that the aorta is affected.

It may be objected that however interesting such aortic radiologic findings may be they have not a very great practical value owing to the experience which they demand in the radiologist in interpreting the degree of opacity of an aorta. There is no question but that the examination and interpretation are of extreme delicacy and call for a special training, not possessed by all radiologists. But does not the progress of radiology in every branch of visceral pathology depend upon details and shades, and is not the consequence of every technical progress a forced training and adaptation in order that such progress may become known by all? There is no question here of sacrificing clinical methods for those of the laboratory. Clinical study still remains above everything; but like everything else clinical study has its limits and we must recognize that there are cases in which appeal must be made to the laboratory.

ZACHERL, H., AND LUNDWALL, K.: THE VALUE OF PROPHYLACTIC ROENTGENOTHERAPY IN CERVICAL CARCINOMA (UEBER DEN WERT DER PROPHYLAKTISCHEN ROENTGENBESTRAHLUNG BEIM COLLUMKARZINOM). *Zentralbl. f. Gynaek.*, 1923, XLVII, 633.

The authors quote several writers such as Gauss, Heimann, Warnekros, Steiger, and Adler, whose reports show that post-operative irradiation has reduced the percentage of recurrence in operated cancer by figures varying from 33 to 99 per cent. Some, such as Perthes, Tichy and Kaestner, have reported increase after irradiation varying from 11 to 69 per cent. The bad results reported were more usual in cases of carcinoma of the breast, but cancer of the reproductive organs in the female seems to be more amenable to the action of the roentgen rays. It is, of course, possible that the poor results were due to faulty technic, the use of too heavy a dosage of rays.

In their own cases post-operative irradiation has been routine since 1914. In the early cases a séance was given every two weeks, in the latest cases the patients receive two treatments per year. Six abdominal and three lumbar fields are irradiated under 3 mm. aluminum filter, the focal distance being 30 cm. and the dosage being about two-thirds the erythema dose. Sixty-nine cases have been treated and of these 49.28 per cent have remained without recurrence for a period of five years or longer. The treatments are more frequent in the first year after operation and then gradually decrease to two per year.

MIDDLETON, W. S.: COSTODIAPHRAGMATIC ADHESIONS AND THEIR INFLUENCE ON THE RESPIRATORY FUNCTION. *Am. Jr. Med. Sci.*, Aug., 1923, CLXVI, p. 222.

The importance of the diaphragm in the respiratory function is pointed out. In anatomical relations and physiological functions, the diaphragm ranks second only to the heart among muscular structures. Various estimates have been made of the part played by the diaphragm in respiration. The diaphragm moves 1.5 cm. in quiet respiration and 3 cm. on forced

respiration. If, then, the average area of the diaphragm being determined to be 250 sq. cm. in contact with the lung, and there is a descent of 10 mm. in the diaphragm, the increase in thoracic space would be 250 c.c. If 400 c.c. be taken as the normal tidal air, the diaphragm must be considered a large factor in quiet respiration. Any disturbance in the function of the diaphragm then would seriously embarrass the respiratory function. Pryor's previous observations on 83 individuals who had suffered from empyema or pleurisy with effusion, showed 53 to have absolutely immobile diaphragms. Of the remainder, 17 showed some restriction in motion.

Fifteen patients who had previously been afflicted with empyema or wounds of the thorax were studied by the author and their diaphragmatic movements noted: The diaphragm was practically immobile in all cases. Vital capacity figures ranged from 57.2 per cent of normal to 75.6 per cent. Pryor's conclusion of an actual paralysis of the diaphragm was disproved by observations of the movement of the costal margins. In the event of unilateral paralysis, the affected leaflet should be elevated upon inspiration because of the unopposed increase in abdominal pressure from descent of the intact leaflet. In no case was this balance movement noted.

A second group of six cases with impaired mobility was collected. The average vital capacity reading was 87.6 per cent of normal.

In conclusion, it would seem that the part of the diaphragm in deep respiration has been underestimated. From the present vital capacity studies the normal diaphragmatic contraction must account for at least 60 per cent of the respiratory interchange in deep breathing.

Protection of the diaphragm from needless trauma and continued contact with inflammatory products will limit the occurrence of disabling costophrenic synechiæ. Lastly, avoidance of protracted diaphragmatic immobility is essential for a complete restoration of function. Early and continued breathing exercises are advised in all cases of pleural inflammation involving the diaphragm.

L. R. Sante, M.D.

Navarro Canovas, B.: Roentgenotherapy in Cancer of the Breast (La roentgenotherapia en el cancer de la mama). *Siglo méd., Madrid,* 1922, LXX, 173.

Experience has shown that the treatment of choice in cancer of the breast is the combined or radio-surgical method. There are cases in which roentgenotherapy will be the only recourse, when surgical treatment, for some reason, is contra-indicated.

Radio-surgical treatment has for its object the removal of all the large and small masses of tumor clinically appreciable, and the destruction of all those cellular elements which the surgeon can neither see nor extirpate. Radiotherapy ought to precede and follow operation. It should precede in order to exercise an inhibitory action on the cancer cells in the operation, and it should follow to complete the destruction of all diseased tissues. The axillary region always, and occasionally the supraclavicular and the upper part of the pectoral, should be irradiated in order to attack all the lymphatic routes which spread from the breast to the lateral part of the neck.

In the author's experience patients operated upon at the beginning period of cancer and repeatedly and suitably irradiated do not show recurrence. But in patients operated upon and not sufficiently irradiated recurrence is more or less certain even after a long delay. In some of Navarro Cánovas' first surgical and irradiated patients an interval of 9 years has passed without recurrence. But even if an axillary infarct should appear hope need not be abandoned, as it is amenable to rapid and energetic radiologic treatment. Hard rays are employed. The therapeutic effect of roentgen irradiation increases with the hardness, and superficial lesions yield to this class of rays much better than to bland irradiation. Very rapid intense irradiation should be employed if the patient can tolerate it. But it happens that cytolytic phenomena developed by the rays are at times so violent that patients suffer from intense intestinal colic, fever and other reactions, which are the result in great part of organic intoxication due to tumor products. It is fundamental to employ ultra-rapid irradiation to prevent proliferation of tumor elements.

Teachenor, F. R.: Pneumoventricle of the Cerebrum Following Fracture of the Skull. *Ann. of Surg.,* Nov., 1923, p. 561.

A case report with roentgenograms is given showing air in the ventricles of the brain following fracture of the skull.

The patient, an adult male, age 60, entered the hospital while in an intoxicated condition. X-ray of the skull disclosed a linear fracture beginning in the posterior superior part of the right parietal bone, extending downward and inward through the external auditory meatus. There was no evidence of depression. The lateral cerebral sinuses were distended and filled with air. Roentgenograms taken eighteen days later showed a complete absence of air in the ventricles. The patient experienced no un-

usual manifestations other than those incident to a fracture of the skull. A review of the literature on the subject accompanies the report.

L. R. SANTE, M.D.

MORRIS, R. S., AND LITTLE, C. F.: THE PHYSICAL FINDINGS IN PERICARDITIS WITH EFFUSION. *Am. Jr. of Med. Sci.*, Nov., 1923, p. 625.

The diagnosis of pericarditis with effusion is often a matter of great difficulty. Even with the most painstaking physical examination, a large effusion may be missed, as all clinicians who follow their patients to the autopsy table realize. This fact indicates that the physical signs of pericardial effusion are not always distinctive, and led to experimental investigation on the subject. Ascitic fluid was injected into the pericardial cavities of fresh cadavers and the cadavers examined, particular attention being paid to the shape of the cardio-hepatic angle and to the shape and extent of the relative cardiac dullness and the cardiac shadow in radiograms. It was found that the cardio-hepatic angle is acute —at the most, a right angle, but never obtuse in the injected pericardium, even after the introduction of two liters of fluid. The least amount of fluid showing was 250 c.c., but ordinarily 500 c.c. had to be injected before definite indication was seen in the roentgenogram or could be shown on percussion. The paper is illustrated by roentgenograms and diagnostic drawings.

CONCLUSIONS

1. The cardio-hepatic angle in pericardial effusion is usually an acute angle.

2. The area of relative cardiac dullness in effusion is pyriform and generally extends upward to the first interspace.

3. Widening of the area of dullness and of the shadow in the first and second interspaces occurs relatively early in effusion and is best determined with the patient in the recumbent posture.

4. Shifting dullness (i. e., a narrowing of the dull area, with a corresponding decrease in width of the shadow over the great vessels when the patient is changed from the recumbent to the erect posture) has proven to be the most reliable physical sign of fluid in the pericardium.

5. Widening of the dull area and of the shadow to right and left above the diaphragm when the patient is erect is found with fluid.

6. There is an absence or marked decrease of visible pulsation in the shadow fluoroscopically in pericardial effusion.

7. Dullness at the angle of the left scapula is often present with a large accumulation of fluid in the pericardium.

L. R. SANTE, M.D.

SMITH, C. E., AND RUSK, G. Y.: PRIMARY SARCOMA OF THE ESOPHAGUS. *Ann. of Surg.*, Nov., 1923, p. 577.

A review of the literature shows that primary sarcoma of the esophagus is a rare affection. Sarcoma of the pharynx is not so uncommon. Clinically there was no difference in symptomatology between sarcoma and carcinoma of the esophagus. The growth was polypoid, spindle-cell fibrosarcoma of the lower end of the esophagus.

The thirty-five cases reported are discussed.

Table 1 shows the reported cases of primary sarcoma of the esophagus. In discussing Borrmann's case at the German Pathological Congress, Lubarsch mentioned a polypoid fibrosarcoma which he had found in the esophagus of a horse. Orth referred to a case in the Berlin museum similar to that of Borrmann. M. B. Schmidt mentioned a case of rhabdomyosarcoma which came to autopsy in his clinic at Zurich.

In addition to the cases given in Table 1 the following cases have been discussed by various authors:

Oppenheimer reported a case as primary sarcoma of the esophagus without microscopic studies. From the description this was apparently an aneurism of an esophageal artery filled with a laminated clot.

In the cases of Korner, Albrecht and Paget the tumor arose in the pharynx.

In the cases reported by Rotschy, Perez, Kundrat and Schlagenhaufer the tumor arose in the mediastinum with secondary involvement of the esophagus.

The case reported by Huismans was probably a primary sarcoma of the femur with secondary involvement of the esophagus.

Kraus says that the case reported by Butlin was primary sarcoma of the tongue.

Von Hansemann reported a case of carcinoma-sarcomatodes of the esophagus, but original report was not available.

An analysis of Table 1 shows the following:

Including our case, thirty-five, of primary sarcoma of the esophagus have been reported. The average age of these patients is 53.6 years. The condition is much more common in men. Where sex is given, there are 26 men and 7 women.

Practically every case showed dysphagia due to stenosis or obstruction by the tumor. Pain was present in many cases, its location varying according to the site of the tumor.

In 24 cases the tumor occurred in the lower half of the esophagus. It was found in the upper half in 8, in the middle in 1, and in 2

cases the growth involved both middle and lower part.

In 14 cases the growth was polypoid, in 12 nodular and diffuse, in 9 annular. Many in the last two groups showed ulceration.

It seems probable in all cases except the myosarcomata that the growth originated in the submucosa.

Classification according to type of cells shows: 11 spindle cell, 7 mixed spindle and round, 5 round, 5 myosarcomata, 2 melanosarcomata, 1 lymphosarcoma, 1 lymphoangioendothelioma, 1 endothelial sarcoma, 1 carcinoma-sarcomatodes, and 1 where type is not given.

Sarcoma of the esophagus apparently grows more rapidly than carcinoma, but metastases do not seem to occur as frequently as one usually finds in sarcoma elsewhere in the body. In 17 of the above cases no metastases were found. In most of the others only the adjacent nodes were involved; in some, however, extensive metastasis occurred.

In the cases of Lange, Reutter and Frangenheim carcinoma of the esophagus occurred as separate and distinct tumors coincident with carcinoma. In the case of Herxheimer the tumor was estimated as two-thirds spindle-cell sarcoma and one-third epidermoid cancer and was called carcinoma-sarcomatodes.

In the cases of Shaw, Rolleston, Livingood, Reutter, Wegener, Baur and the second case of Starck, the tumor had perforated the esophagus with sinuses to trachea, bronchi or lungs, with gangrene of the lungs in some cases.

In many cases gastrostomy was necessary, due to stenosis or obstruction in the esophagus caused by the newgrowth. In only one instance, the second case of von Hacker, was resection of the esophagus performed. The growth recurred in adjacent tissue in the cervical region and the patient died three months later of bronchopneumonia.

It seems possible that operation might effect a cure if the patient is seen early, especially in the case of the more slowly growing, polypoid fibro-sarcomata.

L. R. Sante, M.D.

Holmes, G. W., and Dann, D. S.: Cardiac Pneumofibrosis. *Am. Jour. of Roentgenol.*, Vol. X, 1923, p. 343.

The authors take up in detail the pathology and the radiographic appearance produced in chronic pulmonary congestion of the lungs. Assmann has written one of the best descriptions of this lesion and the authors quote him in detail. The two main changes seen in the roentgenogram in cases of decompensation with passive congestion are: First, a washed-out appearance of the plate which makes it look as if improperly exposed or faulty and, second, a broadening and increased prominence of the normal lung markings made up by the larger and medium sized blood vessels. Accompanying this there is an increased prominence of the smaller markings lying adjacent. These increased markings run from the hilus to the periphery, decreasing in size and intensity as they go outward. The condition differs from local thickening of the bronchial walls in bronchiectosis.

According to Stillman and Robinson, dyspnea, cyanoses, cough, hemoptysis and bronchitis are the cardinal symptoms of this condition. The pathology of the condition is fairly typical. The lungs are pale, either dry or edematous, dense but still elastic and have a distinct rusty brown pigmentation. Microscopically the capillaries in the alveolar walls are greatly dilated and tortuous so that they project in loops into the alveolar cavities, the alveolar epithelium and other cells are desquamated and fluid exudes from the tense capillaries. In chronic cases the alveolar walls are greatly thickened and indurated due to the presence of new connective tissue. In the roentgenogram the extent of change from normal varies, depending on severity and duration of the disease. Early changes are seen at the hilus and as the process progresses extend along the bronchial tree into the lung fields. In extreme cases the entire lung field may show these changes. The characteristic finding is an increase in size and density of hilus shadow. The lung markings while accentuated appear hazy and indefinitely defined and these changes may be accompanied by rather sharply defined irregular areas of uniformly increased density, seen most frequently in the lower part of the chest around the descending bronchi. The lung findings are invariably accompanied by an abnormal appearance of the heart's shadow. In the differential diagnosis secondary malignancy of the infiltrative type must be excluded. As a rule, in malignancy the heart shadow is normal in size and shape, the hilus shadows more irregular and more sharply defined, the distribution along the bronchial tree is more irregular and the process is fairly uniform in distribution, whereas in fibrosis it is more marked in the lower lobes.

In pneumoconiosis the distribution of the densities is more even throughout the lung fields. There is absence of any marked enlargement of the hilus shadow and as a rule the heart shadow is normal.

In excluding tuberculosis the distribution, the sharper markings and the annular shadows due to cavities aid in its differentiation from fibrosis. In addition, the heart shadow is generally nor-

mal and the lung fields are not so hazy. At times the two conditions may co-exist.

The authors give four histories as illustrative of the cases studied and have seven well-selected roentgenograms illustrating the various points brought up in the diagnosis and differential diagnosis.

SKINNER, E. H.: LYMPHOSARCOMATA AND OTHER GLANDULAR ENLARGEMENTS OF THE NECK: THEIR RADIATION TREATMENT. *Jr. Mo. St. Med. Assn.*, Nov., 1923, p. 377.

1. Glandular enlargements of the neck are of frequent occurrence.
2. They are difficult to differentiate and are the sporting grounds of pathological discussion.
3. They are unfavorable surgical situations.
4. They are favorably influenced by radiation in dosage of wide variation.
5. They are symptomatically cured, progressively recede and remain quiescent or fail to recur for longer periods under radiation therapy than under surgical treatment alone.

Glandular tumors of the neck may be lymphosarcomata, Hodgkin's disease, lymphatic leukemia, pseudo-leukemia, chloroma, Banti's disease, tuberculous, acute and chronic infections, adenopathy and carcinomata, primary or metastatic.

Differential diagnosis of the chronic, slow-growing tumors furnishes a most gorgeous speculative field.

A study of the literary background discovered a most simple and satisfying description of lymphosarcoma by Sternberg in 1903. "Lymphosarcoma is a tumor formation starting in a group of lymph nodes and spreading thence to neighboring nodes or follicles. It spreads from region to region without ever exhibiting such general lymphoid involvement as leukemia or pseudoleukemia. Sooner or later it invades the capsule and extends into the surrounding tissue. Metastases differ from those of ordinary neoplasms in that the intervening lymphoid tissues are affected. True metastases, which can be explained only through transfer by way of the blood stream, are rare and usually isolated. Blood vessels are seldom invaded by lymphosarcoma, being usually only surrounded and narrowed. The commonest sites of origin are the lymph nodes of the neck, mediastinum, mesenteric and retro-peritoneal regions, less frequently the inguinal and axillary nodes. The affected groups form nodular, uneven masses well limited in the beginning but later diffusely permeating the surroundings. They are mostly hard grayish-white, and show a homogeneous cut surface. In general, when a hollow organ is invaded, the growth tends to form a sleeve-like mass about it, usually, however, causing no obstruction, but on the contrary tending to widen the lumen."

Even eminent observers report successive changes in the career of a lymphosarcoma into lymphatic leukemia and thence to Hodgkin's disease.

The surgeon cannot cut out what he does not feel or see or suspect. Surgical ablation of any lesion must be beyond tumor limits and chains of lymphatic glands are difficult to eradicate completely.

Radiation therapy does influence the glandular enlargements under X-ray or radium. The dosage of these two agents has been of wide variation among many radiologists and of progressively increasing intensity by the same individual. The value of any therapy becomes more universal as its flexibility of dosage and method increases.

In the author's cases, which are the stimulus for this report, the technic varies from the old gas tube to the Coolidge tube, from filtration of 1 mm. of aluminum plus sole leather to .5 mm. of copper; from questionable small voltage to 140 kilovolts. It includes radium from the amounts of 25 mg. to 200 mg. and this from surface to distance application. It has always been an ambition to irradiate to the limits of our possessions and knowledge.

It is a chronological paradox that the cases treated with the earliest and seemingly inadequate dosage are the longest free from recurrence. We have three lymphosarcomata well for 9, 8 and 7 years, respectively.

There are 25 cases as a clinical framework of this argument. Most of them have been treated since the war and are therefore within a three-year period. Many of them have had surgical attention. None of these were acknowledged carcinomatous. One known case is dead. Two are lost. The majority have been remarkable exhibits of the ability of radiation therapy to knock down or eradicate glandular masses in the neck.

L. R. SANTE, M.D.

BAKKE, S. N.: SPONDYLITIS TYPHOSA. *Acta Radiologica*, Vol. II, Fasc. 2, 19: V, 1923, N: '06.

Quencke in 1899 described in detail a case of spondylitis typhosa setting forth as the cardinal symptoms: (1) the extraordinarily intense and diffuse local pain; (2) the acute course; (3) the rapid abating of spinal pain; (4) the noticeable swelling of the soft parts of the spinal column.

The author presents a typical case of this affection, the spinal symptoms coming on 3

months after the patient's attack of typhoid fever. Onset was sudden with intense pains in the lumbar region of the vertebral column, accompanied by a remittent fever. The pains persisted only a short time, leaving a stiff back which was painful on motion. The man presented himself for roentgenologic examination Jan., 1922, 3 months after acute symptoms had subsided. The roentgenogram showed an arched exostotic connection between the bodies of the second and third lumbar vertebræ on both sides, together with a diminished space between the two vertebræ. There was no apparent deficiency of line anywhere in the vertebral bodies. The lateral view showed the cartilage disc between the two vertebræ to be thinned but still intact. The hyperostotic connection was seen stretching from the center of the body of the second to the upper border of the third lumbar vertebra lying in front of the column.

Later (in May, 1922), the roentgenogram showed a transparent area about 1 cm. in diameter in the middle of the body of the second vertebra. There has been no destruction of the bodies of the vertebræ so far.

The differential diagnosis between this lesion and spondylitis tuberculosa is quite easily made since in this case there is no marked arthrophy of lime and no destruction of the vertebral body. In addition, there is a proliferative process going on with a bridge-like connection between the second and third lumbar vertebræ.

K. S. Davis.

Steiger, M.: Radiotherapy of Polycythemia (Die Roentgenbehandlung der Polycythaemia rubra). *Schweiz. med. Wchnschr.*, 1923, LIII, 376.

In the literature of the past ten years Steiger has found 27 cases of polycythemia rubra treated by radiotherapy, and to these he adds four personal cases. Study of these cases shows that radiotherapy is the only efficacious treatment of the erythemia, and that it can bring about cures which both clinically and hematologically appear to be permanent.

The radiotherapy to be effective must be upon the soft bone. Splenic radiotherapy is inefficacious both in the Vaquez (splenomegalic) and in the Geisboeck (hypertensive) types of the disease. These conclusions of the author are similar to those reached by Béclère.

There is no need to persist too much in radiotherapy; it suffices to restore the blood formula to the vicinity of normal rather than to bring it to normal or below normal, as this may be dangerous and the irradiation would then do more harm than good. In the first of Steiger's four personal cases the red corpuscles were reduced from 7,000,000 to 4,890,000 within two months; in the second case from 6,500,000 to 5,800,000; the third case was one of splenomegaly and erythemia, the erythemia being improved; in the fourth case the patient had 140 per cent hemoglobin, and 15,000,000 red corpuscles; after four séances of osseous radiotherapy this patient showed only 5,424,000 red corpuscles and an excellent general state, which was maintained.

Grasmann, K.: Late Roentgen-Ray Burns of the Skin (Ueber Roentgenspaetschadigungen der Haut nebst kasuistischem Beitrag). *Deut. Zeitschr. f. Chir.*, 1923, CLXXIX, 115.

Grasmann reports a case in a woman, aged 49, whose ovaries were irradiated in 1916 when she was treated for bleeding uterine myoma. A typical roentgen-ray ulcer developed four years later in the right buttock, well within the focus exposed to the rays. The ulcer and surrounding tissue were excised and there have been no local disturbances since. In another case a late roentgen ulcer healed under an air-tight rubber dressing within a few months.

Warren, S. L., and Whipple, G. H. The Path of a Beam of Hard Rays in the Living Organism. *Jour. of Experimental Med.*, Dec. 1, 1923, p. 731.

Do the hard rays follow a straight and narrow path from the target of the X-ray tube through the tissues of the human body?

Do these hard rays suffer from reflection or refraction and therefore influence tissues outside of this direct pathway?

What factor is secondary radiation in the treatment of disease and does such secondary radiation exert a toxic effect on tissue cells or tumor cells outside of the direct pathway of hard X-rays? That the therapeutic effect is entirely produced in the direct path of the X-ray beam is evidenced by the abrupt transition between the epithelium of a dog's small intestine, following X-ray exposure, from the normal adjacent epithelium of the unradiated area.

X-rays which injure intestinal epithelium (and presumably other body or tumor cells) travel in straight lines from the target through the living tissues, forming a cone or beam of rays as controlled by impervious screens.

It is probable that secondary radiation is formed, especially deep in the body tissues, but such radiation does no injury to intestinal epithelium outside of the cone, or path, of radiation.

Lesions in the stomach and intestine may be confidently predicted from a knowledge of the size and form of the cone or beam of X-rays

given over the abdomen. These lesions, even more than skin burns, do not heal and may, in fact, go on after many weeks to perforation.

Even in the depths of the abdomen the duodenal lesions are as clean-cut as a peptic ulcer, indicating the lack of dispersion or scattering of the primary or secondary rays in passage through the living tissues. Transition from normal to necrotic mucosa rarely occupies more than 2 to 3 mm., and often can be observed in a single low-power microscopic field.

L. R. SANTE, M.D.

KUTZMANN, ADOLPH A., AND GIBSON, THOMAS E.: MALIGNANT TUMORS OF THE TESTICLE IN CHILDREN. *Ann. of Surg.*, Dec., 1923, p. 761.

A detailed report is made of a testicular tumor with extensive metastasis in a boy aged 10 years. The rarity of the condition is pointed out, occurring originally in the left testicle. The tumor recurred after removal, and, extending along the spermatic cord, metastasized to the retroperitoneal structure and thence to the chest. An endeavor was made to classify the tumor according to the type of cell present, but this varied with the various sites of the lesion. The inadequate classification of tumors of the testicle is pointed out.

An investigation of the literature would seem to indicate that there exists two large groups, the teratomata (heterologous tumors) and the "seminomes" (homologous tumors), the tumors of other types being extremely rare. The following classification is borrowed from an article by Schultz and Eisendrath and is proposed as the most logical and complete in our present knowledge of the subject:

I. Homologous Tumors:
   A. Benign:
      1. Epithelial:
         (a) Adenoma of the seminal tubules (the tumors of Chevassu and of Pick [Ewing]).
      2. Mesoblastic:
         (a) Fibroma, arising in the tunica (the tumors of Lardennois and Lecene, Makins and Boyer).
         (b) Leiomyoma, arising in the epididymis (Ewing accepts the tumors of Trelat, Rindfleisch, and Hericourt; Schultz and Eisendrath report a similar case).
         (c) Vascular tumors (lymphangioma, hemangioma).
         (d) Interstitial cell tumors (Ewing considers a specimen in his own laboratory and the case reported by Chevassu, as examples of hyperplasia rather than neoplasia).
   B. Malignant:
      1. Epithelial:
         (a) Spermatocytoma (seminome of Chevassu).
      2. Mesoblastic:
         (a) Sarcoma (extremely rare; possibly Sakaguchi's case and three of Miyata's cases arising in the tunics may be accepted).

II. Heterologous Tumors:
   A. Benign:
      1. Cystic dermoid:
   B. Malignant:
      1. Embryonal carcinoma. Heterologous tissue may be present or may have been overgrown. The atypical tissue may be:
         (a) Trophoblastic (chorio-epithelioma).
         (b) Hypoblastic (the usual adenomatous tumor).
         (c) Epiblastic (solid alveoli of basal cell type or tumors of neurocytoma type).
      2. Sarcomatous mixed tumor (true sarcoma in a teratoma seems to be rare).

L. R. SANTE, M.D.

LANGE, L., AND FRAENKEL, M.: ACTION OF ROENTGEN RAYS ON TUBERCULAR BACILLI (DIE WIRKUNG VON ROENTGENSTRAHLEN AUF TUBERKELBACILLEN). *Klin. Wchnschr.*, June 18, 1923, p. 1161.

The authors have made certain researches from which they arrive at the conclusion that

roentgen rays are capable of killing tubercular microbes when they are exposed under the form of a 1: 10,000 suspension. But this action is produced only when the bacilli come from bouillon cultures of about four to five weeks old or more, even when animal inoculations still show these cultures to be fully virulent. On the other hand, if cultures coming from fresh bouillon preparations are exposed to the same irradiations, or if they do not exceed seventeen to twenty days in age, the bacilli resist. The authors conclude that the law formulated by Tribondeau and Bergonié, according to whom young cells would be those most radio-sensitive, does not apply to microbian cultures.

JONES, N. W.: ILEOCECAL INCOMPETENCE. A CLINICAL ANALYSIS OF 1,000 CASES, WITH SOME DEDUCTIONS THEREFROM. *Am. Jr. of Med. Sci.*, Nov., 1923, p. 710.

Incompetence of the ileocecal valve as a cause of subjective symptoms has been a matter of controversial discussion for a number of years. Some deny that ileocecal regurgitation has any clinical importance, while others ascribe all manner of ills to this condition. It is within the knowledge of many roentgenologists that incompetency of the ileocecal valve is a very frequent occurrence. To determine the relationship of this condition to subjective symptoms this study was undertaken.

They have found from a study of these cases that clinically the relief of symptoms does not depend upon the removal of an ileocecal regurgitation, and also that a distinct ileum stasis is sometimes not recognized by discomfort. They are likewise shown that some of these individuals have not obtained relief under the most careful control until after the loosely fixed right colon has been properly placed upon the kidney shelf, which alone seems to permit a regulation of the bowel that affords relief.

The fixation of the colon alone seldom or never permits the bowel to regulate itself. A process of dietetic training incident to the tender spastic colon is necessary and oftentimes it must be carried out over a period of years.

CONCLUSIONS

1. Competency of the ileocecal valve in some persons may be demonstrable throughout a period of one hour. It may be assumed to be permanent in them.

2. Ileocecal incompetency occurs without symptoms in a moderate percentage of healthy persons. The majority of the instances occur in conjunction with a mobile cecum. In such persons the degree of regurgitation is usually small.

3. The incompetency is of frequent occurrence in persons who have abdominal distress.

(*a*) The relief of such symptoms may not be accompanied with the overcoming of regurgitation.

(*b*) The relief of such symptoms seems to be directly related to the re-establishment of the normal gradient of intestinal forces, as suggested by Alvarez's work.

4. Over 80 per cent of cases of ileocecal incompetency occur in association with a determinable degree of cecum mobility.

5. A small number of ileocecal regurgitation cases, with and without mobile cecum, are found in which neither the stasis nor the symptoms of it can be removed by dietetic measures alone. The end-results following the surgical treatment of such cases justify the surgical measures employed.

6. The operative procedures alone do not relieve the patient of his distress. They merely place the patient back in the large group of relievable cases which depend upon dietetic and reconstructive methods of treatment for their cure.

L. R. SANTE, M.D.